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Contributions from the Cryptogamic Laboratory of Harvard University. XXX.

New or peculiar aquatic fungi. 3. Blastocladia.

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WITH PLATE III.

In the two preceding notes on aquatic fungi reference has several times been made to a paper by Reinsch[1] in which, among other interesting forms, he describes the curious genus *Blastocladia;* including the single species *B. Pringsheimii*, which, as far as the writer is aware, has not been again observed. The genus has since been wholly ignored by systematists or placed among the doubtful Saprolegnieæ. Fischer in his Phycomycetes[2] includes it among the genera of this group which are doubtful or to be excluded, while Schroeter in his more recent revision[3] finds a place for it among the Leptomitaceæ; on the ground that, although lacking the segmentation so characteristic of this order, it corresponds in general habit to the species of the genus Rhipidium, as was formerly pointed out by Cornu.[4] The uncertainties which have surrounded it have been in part due to a lack of exact knowledge concerning it, and in part to the truly anomalous character of the plant itself, which occupies a distinctly isolated position among other aquatic Phycomycetes.

Notwithstanding the fact that it has remained unknown for twenty years since its original discovery, it has proved in the writer's experience to be one of the more common aquatic fungi, occurring in almost every locality where it has been

[1] Pringsheim's Jahrb. f. wiss. Bot. **11**: 291. 1876.
[2] Rabenh. Kryptogamenfl. **1**[4]: 367. 1892.
[3] Engler & Prantl Nat. Pflanzenfam. 93: 103. 1893. [I Th., 1 Abth.].
[4] Bull. Bot. Soc. de France **24**: 227. 1877.

sought for, both in the vicinity of Cambridge and of Kittery Point, Maine. The present note therefore is based on the examination of very abundant material from widely separated localities, which illustrates by an almost unbroken series the wide range of variation for which this plant is remarkable.

In general terms the fungus may be described as consisting of a highly developed unicellular main axis ("Hauptstamm") more or less clearly differentiated, which may remain simple or become distally variously branched, and is attached by copious rhizoids to the substratum on which it grows. The branching of this axis may be sub-umbellate or irregularly dichotomous, while the branches themselves may be in turn several times more or less irregularly branched, varying greatly in size, habit and appearance. The axis if it is simple, or its ultimate branches when it is otherwise, become as a rule more or less abruptly swollen distally into often well developed heads from the surface of which are produced, terminally or sub-terminally, the organs of reproduction, as well as certain peculiar sterile branchlets which will be mentioned subsequently. In some branched forms, however, this terminal swelling is not noticeable, the reproductive organs being borne singly at the tips of short ultimate branchlets (fig. 6). Apart from these organs which are separated from it by septa, the plant consists, as has been just mentioned, of a single cell, in the contents of which certain spherical oily masses, very variable in size, are usually conspicuous (figs. 1 and 3). These masses, which are sometimes wholly absent, were described by Reinsch[5] as independent cells endogenously formed, at first free in the protoplasmic contents and later giving rise to the reproductive organs. After fixing themselves to the inner surface of the wall of the terminal enlargement of the axis already mentioned, they were said to burst through to the outside and develop into sporangia, "oospores" or "antheridia?" according to circumstances. In fresh material these bodies resemble homogeneous refractive oil globules; but when stained they seem to consist of a coherent mass of coarse granules, having the appearance represented in fig. 3. In his examination of these bodies, however, the writer has seen nothing which would indicate the

[5] "Diese Zellchen legen sich an die innere Schlauchwandung an, durchbrechen — von der Beruhrungsstelle mit der Schlauchwandung auswachsend — die Membran des Schlauches und kommen auf der Aussenseite der Schlauchwandung als kleine Hökerschen zum Vorschein."—Reinsch l. c. 292.

truth of this, in itself improbable, supposition of Reinsch. Although they are somewhat peculiar from the fact that they stain readily, and permanently retain their form and characteristic appearance after the plant has been crushed and its contents scattered in the surrounding medium, there seems no ground for the belief that they are anything more than masses of fatty protoplasm, as would naturally be inferred from the fact that they may be present or absent according to the character of the nutrient substratum. The variation in size of such masses in a given individual is usually extreme, some appearing as mere minute granules, while others nearly fill the terminal heads. In no instance, moreover, has the writer seen one which seemed in any way to connect itself with the formation of one of the buds which develop into reproductive organs.

The zoosporangia first make their appearance as papillæ formed at or near the extremity of the axis or of its branches, which are soon cut off by septa as independent cells (fig. 4, at the left) and soon increase in size, assuming the form characteristic of the mature sporangia. The latter vary very greatly in shape and size, so that any one who chanced to find the extremes of variation without knowledge of intermediate forms would hardly hesitate to separate such varieties as distinct species; especially in view of the fact that variations in the sporangia are often associated with differences almost as extreme in the form and size of the resting spores as well as in the general habit of the main axis. From slender elongate nearly cylindrical zoosporangia (fig. 2) to much shorter and stouter (fig. 3) or even broadly oval forms, every gradation may be found; but in a given individual there is usually a general uniformity in their size and shape. They are formed in considerable numbers on a given tip, usually at its summit; but sometimes also in small numbers laterally below it, and when mature the contents divide into a very large number of zoospores, while a thickened papilla of dehiscence is formed at the apex (fig. 10). Finally this papilla, as it begins to deliquesce, is pushed off by the mass of zoospores within, and the latter make their escape one by one, swarming almost immediately, The empty sporangium wall eventually disappears, leaving a circular scar where it was attached, and the fertile surface of exhausted plants is thickly studded with such marks.

The zoospores are peculiar in appearance and can readily be distinguished from any similar bodies known to the writer by the characteristic disposition of their contents. In general form they are oval or elliptical and are, at least in many cases, biciliate; the two cilia arising side by side from the smaller end of the spore. In some instances it has been found impossible to make out more than a single cilium even after the zoospore was stained; but the presence of two (fig. 11) has been determined definitely in so many cases that this number may be considered as typical. The nucleus is very large and sub-triangular in outline, its base connected with that of the cilia by a fine strand of granular protoplasm. In front of the nucleus lies a broad and distinct mass of granular protoplasm while small groups of granules occur here and there around it in the otherwise nearly clear cytoplasm. In general appearance they are not unlike the zoospore of Gonapodya, but may always be distinguished by the form and position of the nucleus and the evident connection of the latter with the base of the cilia. As the fungus developes, growing as it almost invariably does in tufts, it forms the center of a dense mass of bacteria which finally choke the sporangia completely; so that as a rule only those first formed are able to discharge their contents. As a result the zoospores commonly die without escaping; the remains of their large nuclei just mentioned filling the sporangia, as is indicated in the central sporangium of fig. 3. These dead nuclei were taken by Reinsch for the zoospores themselves and are represented in his plate XVI, fig. 8.

Associated with the sporangia are often found numerous slender filaments which arise as buds in a fashion exactly similar to that by which the former are produced. They are very slender, simple or irregularly branched, without septa, and often greatly exceed the sporangia in length (fig. 2). In a majority of cases, however, they are wholly absent or undeveloped (fig. 1 at the right) and they seem to bear no definite relation either to the sporangia or to the resting conidia. They seem to be quite sterile and although Reinsch suggests that they may be antheridia they are probably without definite function, and are certainly not male organs.

The resting spores, already referred to, and described by Reinsch as doubtful oospores, do not as a rule make their appearance until some time after the sporangia have been de-

veloped; in other words the former are characteristic of the earlier, the latter of the later conditions of the plant. In origin these spores correspond in all respects to the sporangia; arising as buds from the surface of the swollen extremities of the axis from which they are soon separated by a septum. As they mature they usually assume a more or less oval form, become very thick walled and when ripe fall readily from their attachment, leaving a circular scar. The mature spore has two walls, an outer, thin and even, and an inner, thick and curiously modified, so as to present the appearance represented in fig. 12, when viewed in optical section. Whether the characteristic markings figured are really pits, as they appear to be, can hardly be definitely determined without an examination of an absolute section of the wall, and such a section has not been obtained. The surface view of these "pits" is represented by the circular outlines shown in fig. 13. Several large oil globules are usually present in the contents of these resting spores and all attempts to induce them to germinate have proved unsuccessful, although cultures have been continued for more than a month. In form they vary almost as much as the sporangia; being in some cases quite spherical, with a small papilla of attachment as in figs. 8 and 9, in others nearly oval with a broad base as in fig. 7, or long piriform as in fig. 7. There is, however, a notable tendency in a given plant to produce resting spores of a given form even if, as in fig. 8, this form is an unusual one.

As far as can be determined these spores are wholly nonsexual in origin, and the most careful examination has failed to show the presence of anything which could be by any chance interpreted as an antheridium. The absence of any such organ naturally suggested the possibility of the existence of motile antherozoids similar to those found in Monoblepharis; but there is certainly only one kind of sporangium, and even if antherozoids in reality existed, it would be, in almost all cases, quite impossible for them to perform their office from the fact that, by the time the resting spores begin to form, the whole plant is, as has been already mentioned, completely enveloped in a solid mass of bacteria and other organisms which would effectually prevent access to the oogonium, if it were such, by any body dependent on cilia for its motility. The outer wall of the spore, moreover, is always continuous, showing no signs of any perforation or receptive spot.

Among the material collected in one locality near Kittery Point, numerous plants were found bearing peculiar sporangia, proportionately much larger and more nearly oval than the ordinary forms, many of which contained large well defined rounded masses of protoplasm which at first suggested the presence of oospheres; but further examination showed them to be early conditions of the resting spores of a species of Rozella parasitic on the Blastocladia, which, when mature, became spherical, thick walled, and echinulate.

The position of the genus among related forms is very doubtful, and although in habit it resembles Rhipidium, while its zoospores recall those of Gonapodya, there is no reason for believing that it is at all closely related to either of these genera. Its resting spores are in some respects comparable to the deciduous resting conidia of certain species of Pythium, especially in the new form described below, and for lack of any more satisfactory disposition, it may be placed provisionally among the Pythiaceæ; the only alternative being apparently the erection of a special family for its reception.

In addition to the material of *B. Pringsheimii* obtained, a second and much less well defined species was found in company with it in a single locality at Kittery Point. In this form the resting spores are less highly differentiated, though produced in greater abundance, and resemble thick walled sporangia, slightly modified in form. There can however be little doubt of the correctness of the generic reference of the plant, which may be characterized as follows:

Blastocladia ramosa, nov. sp.—Main axis nearly cylindrical, attached to the substratum by rhizoidal divisions of its base; above copiously branched, irregularly or sub-dichotomously, the branchlets producing terminally and sub-terminally sporangia and resting spores. Sporangia broadly oval, bluntly pointed, $30 \times 15 \mu$. Resting conidia terminally bluntly rounded gradually narrower towards the truncate base, about $30 \times 11 \mu$. The whole plant 260 to 600μ high, its main axis 14 to 20μ in diameter.—On submerged twigs, Kittery Point, Maine. Plate III, figs. 14–16.

This species has been found in only one locality growing with *B. Pringsheimii* and other forms in a small pool in a sphagnum bog, and occurred in such small quantity that I was unable to observe the escape of its zoospores; since, in

the material examined, the zoosporangia were comparatively rare. In all cases the resting spores were formed in great profusion and seemed constant in form though somewhat variable in size. Their walls, though usually distinctly thickened, are never as conspicuously so as in the larger species, and might very properly be spoken of as conidia; since, in many instances, even after they are detached, their walls do not appear to be much thicker than those of the sporangia. I have never seen an instance, however, in which one seemed to have discharged its contents like the normal zoosporangia. The species is an insignificant one, and would not have been described without further observation, had it not possessed a certain interest in connection with its more highly developed ally.

For convenience of reference a description of *B. Pringsheimii* is appended, no measurements of this species having been previously published.

BLASTOCLADIA PRINGSHEIMII Reinsch.—Main axis simple or several times successively branched sub-dichotomously sub-umbellately or irregularly, the free extremities usually but not always distally swollen into more or less well defined terminal heads. Reproductive organs, sporangia and non-sexual resting spores, produced terminally and sub-terminally and often associated with slender sterile filaments branched or simple and similarly produced. Sporangia long cylindrical to long oval, more commonly more or less pod-shaped, producing very numerous biciliate zoospores. Resting spores formed like the sporangia, spherical, oval, or long piriform, the wall much thickened and pitted. The whole plant 200 to 750μ in height (exclusive of rhizoids), the larger terminal heads 100–150μ in diameter. Main axis 30–90μ in diameter. Zoosporangia $150\times25\mu$ ($50\times25-225\times18\mu$). Zoospores about $7\times5\mu$. Resting spores 50×30–$75\times44\mu$.—On apples and other decaying vegetable matter in ponds and ditches. Vicinity of Cambridge, Mass., and Kittery Point, Maine. On decaying apples in water, Germany (Reinsch). Plate III, figs. 1–13.

Cambridge, Mass.

EXPLANATION OF PLATE III.

Blastocladia Pringsheimii Reinsch.

Fig. 1. Single plant of large size showing rhizoids; sub-dichotomously branching axis with fatty bodies in its contents; sporangia, many of which are empty (two discharging zoospores); young resting spores and two sterile branchlets.

Fig. 2. An axis bearing two heads with long cylindrical sporangia, some of them empty, and long sterile branchlets.

Fig. 3. An older simple plant with larger fatty masses and mature resting spores; four of the sporangia empty the other two filled with the nuclei of dead zoospores.

Fig. 4. Mature resting spore *in situ*; at the left a young resting spore just separated as a bud from the surface of the head.

Fig. 5. Mature resting spore, surface view.

Fig. 6. Small plant; the habit and the form of the resting spores unusual.

Fig. 7. A branch of the same enlarged, with single terminal resting spore.

Fig. 8. A plant irregularly branched with spherical resting spores.

Fig. 9. Two resting spores of the same, that at the right seen in optical section.

Fig. 10. Sporangium just before the discharge of zoospores showing papilla.

Fig. 11. A single zoospore.

Fig. 12. Optical section of wall of resting spore.

Fig. 13. Surface view of a portion of wall of resting spore.

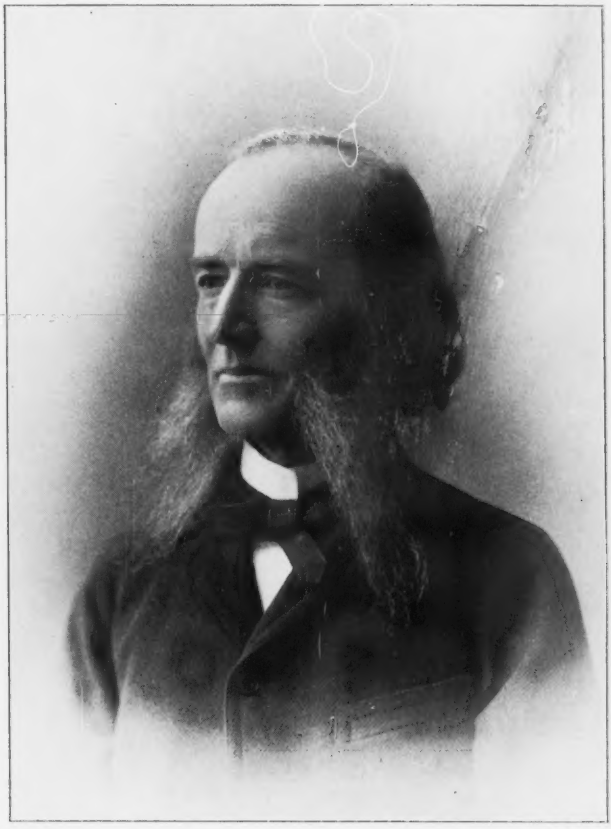
Blastocladia ramosa Thaxter.

Fig. 14. General habit of plant.

Fig. 15. A terminal branch with two sporangia (one of them empty) and six resting spores.

Fig. 16. Two resting spores showing relative thickness of wall.

*** NOTE. The original figures were drawn with the following approximate magnifications in diameters, and have been reduced about one-third by photo-lithography. Figs. 1, 2, 3, 6, 8, 14, × 90. Figs. 4, 5, 7, 9, 15, 16, × 420. Figs. 11, 12, 13, × 925.



MICHAEL SCHUCK BEBB.

Michael Schuck Bebb.

WALTER DEANE.

WITH A PORTRAIT.—PLATE IV.

Once more we are called upon to mourn the loss of one of our leading systematic botanists, Michael Schuck Bebb, a man who in his own specialty stood without a peer, and in whom a gentle refined nature, an enthusiastic pursuit of his favorite study, and scholarly tastes, were joined to a keen and critical mind. He was a true student of nature. Accustomed to an out-of-door life from his earliest years, he acquired a deep love for the world about him and a sharpness of observation that later bore noble fruit when his mind was turned to botanical studies and in particular to the willows.

His early training peculiarly fitted him to deal with a subject that required most careful and patient work both in the field and in the study, and he treated that most difficult genus *Salix* with a master mind. Mr. Bebb won a well-deserved reputation as the leading salicologist of this country and Europe, and his valuable contributions to science will remain as a permanent memorial. Within the past few years our ranks have been sadly depleted by the death of many of the older botanists, men who wrought at the foundations of systematic botany in this country, and to whom the younger generation owes everything. Our friend was one of these. Quietly, unostentatiously, and with unremitting labor he did his work, and with sad but grateful hearts we pay our tribute to his memory.

In the year 1789, Edward Bebb, the grandfather of the subject of our notice, in company with his young bride floated down the Ohio river in a flat-bottomed boat to start their new home in Butler county, southern Ohio. The story of their marriage is a romantic one and deserves special mention. Edward Bebb was a Welshman and, on leaving his old home some years before, to fight his way to success in the new world, he left behind him a young girl, a native of Wales, Margaret Roberts, to whom he was engaged. He intended to return for her later when he had secured a home. There was but little communication between the two countries in those early

days, and as some years passed by and Edward Bebb was not heard from, Mr. and Mrs. Roberts thought that he had forgotten their daughter, and she was persuaded to marry a young clergyman.

The newly married couple sailed for America, but on the voyage misfortune came upon them. A cargo of copperas which the ship had taken on a previous trip had poisoned the water, and this unhappy circumstance caused the death of Margaret's husband and many other passengers. When the ship reached Philadelphia, the young widow made her way to her brother's home in Johnstown, Penn., doubtless intending to stay there till she could return to her native country. Meanwhile Edward Bebb, seeing his way clear to return to Wales for the maiden whom he had not seen for so long, had actually started on his way. His route lay through Johnstown, and there the lovers met. They were married, and over a hilly country they walked for eighty miles to Pittsburg, whence they floated down the Ohio river to the home which Edward had been faithfully preparing. For three years he had been a pioneer in the Miami valley, in southwestern Ohio, clearing up his farm and building his two-storied house of hewn logs.

In 1802, William Bebb, one of three children, was born. As a baby he "was often entrusted to the care of the Indian women," belonging to the friendly Miami Indians who had a camp near by, "and swung from a bough with the rest of the pappooses." His early life was spent on the old place. Arrived at manhood he conducted a successful boarding-school, less than a mile from his old home in the same county, and it was during this time that he studied law and was admitted to the bar. He married Sarah, the daughter of Michael Schuck, a German, and by her he had five children, one of whom was Michael Schuck Bebb.

He was born on December 23, 1833, in the school building, and was named for his grandfather. In later years he described his birthplace thus:—"There was a brick building with hallway through the middle, and a broad veranda and kitchen in the rear, for dwelling and boarding-house; a long frame two-story barn-like structure for dormitory, and a separate schoolhouse. Besides, the older boys had log cabins which they built for themselves and to which they could retire for quiet study or for little suppers of their own which were probably not so quiet!"

Shortly after Michael's birth, the school was closed and in 1835 the family moved to Hamilton, the county seat, a few miles distant, where Mr. Bebb wished to practise law. He had already become a very successful lawyer, as was attested by the comfortable house and ample grounds which they now occupied. Here Michael's boyhood was spent, and here began his first love for botany. "The pleasure grounds, vegetable and fruit gardens," he writes, "occupied four acres. There were four acres more of pasture for the horse and cow," and in addition to this four acres of Morus multicaulis with a cocoonery. "The garden was laid out in old-fashioned geometric style; the borders well filled with rare shrubs and perennials, Holland bulbs, and, I am happy to add, native plants as well." If we add to this a well-stocked greenhouse, twenty by one hundred and fifty feet in dimensions, we can readily understand how Michael early acquired a passion for the study of the plants about him.

He attended a private school, did a boy's share of work on the farm and in the garden, and enjoyed the companionship of the head gardener, whose practical talks on horticultural subjects made a great impression upon him. In later years he spoke with great fondness of this time, and he always dwelt very tenderly upon the influence of his mother, "a fair-haired, comely, serene woman, who had almost the entire care of the social, moral and home life of the family of five children." On the occasion of her death in 1892, he writes, "It was the closing of a long and useful life. Two traits in her character were so predominant as to be at once recognized by every one with whom she came into personal relations; first, an unswerving conscientiousness; second, a wonderful placidity of demeanor." It is when we know of such influences as these that we can understand the genial nature and the true love for home and family that were so prominent in Mr. Bebb.

In his father's library in Hamilton were many books on horticulture, more or less botanical in character, but it was through the influence of his uncle, Evan Bebb, a merchant in New York city, that his father received some volumes relating to purely botanical subjects. These were a complete set of the Natural History Reports of the State of New York, which included the two volumes of Torrey's Flora. A little later Emerson's Trees and Shrubs of Massachusetts was added

to the collection. Young Bebb seized upon these with avidity, for before this, as he himself says, he did not know that there was such a thing as a text-book or introduction to the study of the science, with a key by which the young student might trace the genera and species, and learn something of their relationship.

Mr. Bebb was about sixteen years old at this time, and by these valuable acquisitions, an added impulse was given to his pursuit. He quickly found the key to families and genera. He had never seen anything like it before, and then for the first time he recognized its use and its value. Here was order and system. "Going out into the garden," he says, "I broke off a branch of a native shrub the common name of which was familiar, and easily traced it to Viburnum Lentago. This threw me into a perfect fever of excitement. I rushed out for fresh material with which I was equally successful." The way was now clear, and he quickly became familiar with every tree, shrub and herb about him. He started a little herbarium on sheets of quarto size, preparing the specimens as nearly as possible like the plates in the books he was studying, and drawing on the sheets the flower and fruit analyses. He had no idea that a fruit of any size, such as that of Echinocystis, could be pressed. We must not, indeed, despise the day of little things. From this small beginning and as a direct consequence of it, sprang the splendid herbarium of later years.

In the meantime Mr. Bebb's father had become actively engaged in polities. In the presidential campaigns of 1840 and 1844, he figured prominently as a zealous Whig, and in 1846 he was nominated for governor of Ohio on the Whig ticket and elected by an overwhelming majority. Governor Bebb declined, however, a second nomination and decided to withdraw from public life. Purchasing a tract of land embracing five thousand acres in the Rock river valley, in Winnebago county, northern Illinois, one hundred miles northwest of Chicago, he moved his whole family thither in the spring of 1850. To this estate he gave the name of Fountaindale. The regular route was by canal packet on the Miami canal to Sandusky, and thence by steamer to Chicago. Michael, at this time a boy of seventeen years, full of youthful vigor and enthusiasm, took quite a different course. He assisted his brother-in-law in driving a herd of Short-horn cat-

tle into the state of Illinois. Here was certainly a novel experience. The distance was four hundred miles, and a new flora was constantly opening out before him, giving him fresh delight each succeeding day.

The new home to which we are now introduced was to be the scene of important botanical labors. The boy botanist was to become a trained and skilled veteran, and his efforts were to be concentrated upon his favorite specialty. The estate consisted of beautiful, rolling, prairie land, "well watered," he says, "by cold, clear, spring-fed brooks, along the banks of which, where the water courses had given partial protection from prairie fires, were fine, open groves of oak." The house, built after a design by Charles Downing, was constructed of lumber hauled from Chicago, and was fifteen miles distant from the nearest town. The virgin prairie filled our young friend with eager delight. "Ah!" he writes, "that was lovely beyond description, and a perfect paradise for the out-of-doors botanist." His cup was full and running over with joy when he came into possession at this time of four standard books, Wood's Class Book of Botany, Gray's Botanical Text Book and Manual, Torrey and Gray's Flora of North America, and Gray's Genera Illustrata. Imagine the feelings of a young botanist, longing for the proper kind of systematic instruction, on receiving at one and the same moment such a collection as this. But it was still five or six years more before he was to know the advantage and the keen pleasure to be derived from personal acquaintance with fellow botanists, and the consequent interchange of ideas as well as exchange of specimens.

During the early years of the family life at Fountaindale, Michael, besides working on the farm and studying the native flora, attended Beloit college at Beloit, Wisconsin. About the year 1856 he met by chance, at one of the state fairs which he was attending, Dr. George Vasey, then living at Ringwood, Illinois. The acquaintance soon ripened into a warm friendship, and the reception of a package of grasses, sedges, and junci from Dr. Vasey a few weeks later, gave him the first taste of the delights of receiving authentically named botanical specimens from others. It is interesting to hear what he says of this event. Such enthusiasm belongs to the true botanist. "I cannot tell how rich this made me. I spread the specimens out over the floor, over the chairs, over the

piano. I gloated over them. Here were some of the very things from 'Oneida Co., N. Y.,' mentioned in Dr. Torrey's Flora! What rare and valuable authentic material!"

In 1857 he was married to Katherine Hancock at Barre, Massachusetts, and it was shortly after this that the whole family moved away from Fountaindale, and for a few years Mr. and Mrs. Michael Bebb lived in various parts of the state, in Odin and Salem, southern Illinois, and in Springfield. At these places he made extensive collections of plants. In 1859 he made a trip east and derived fresh inspiration from meeting Dr. Asa Gray. At Springfield, Massachusetts, he attended a meeting of the American Association for the Advancement of Science, where he met the eminent botanists of the day, and he returned home with new and enlarged ideas as to what to do and how to do it. Nobody was more ready to profit by the advice and experience of others.

Meanwhile Mr. and Mrs. William Bebb after leaving Fountaindale went to Knoxville, Tennessee, where Mr. Bebb practised law and interested himself in a Welsh colony which was starting in the mountains of eastern Tennessee. At the outbreak of the civil war, however, the family lost everything, even their personal property, and were driven from the state. They went to Washington where, through the influence of President Lincoln, Mr. Bebb obtained a position in the Patent office. They moved to Rockford, Illinois, in 1869, where Mr. Bebb died in 1873, and his wife in 1892.

In the latter part of 1861 Michael Bebb moved to Washington with his wife and two children and obtained a position in the Pension office. Here he remained till 1867, and in spite of the duties of his office and the troublous times of the war, it was a period of intense botanical delight and activity with him. He quickly became acquainted with the leading scientific men of the city, joined the Naturalists' Club, collected plants eagerly during his hours of leisure, carried on a large correspondence with the botanical world and made copious exchanges. He soon became the intimate friend of Mr. William M. Canby, and his many letters to this well-known botanist are true botanical treasures. They show the real spirit of scientific enthusiasm and give a clue to that love of careful research that enabled him to become so accurate in his observations. He paid special attention to the difficult genus Juncus and illustrated his notes by careful drawings of details.

This material he afterwards handed over to Dr. George Engelmann for his revision of that genus. He numbered among his correspondents at this time, Asa Gray, Canby, Robbins, Vasey, Eaton, E. Hall, Porter, F. Peck, Mead, Blake, Clinton, Bolander, T. F. Allen, T. Green, Gmelin, and many others. The friendships that came to him through his scientific pursuits appealed to him very deeply. In 1862 he writes to Mr. Canby, "Botany is eminently a social science, and among the purest and best of the pleasures the pursuit thereof brings me, I count the friendship of fellow students." How true this was, those who knew him best can testify. He was a most "lovable man" and his intimate friends valued his friendship among their dearest possessions.

In 1865 his wife died, leaving him with three little children, two boys and a girl, and in June, 1866, he resigned his position at the Pension office. On February 19, 1867, Mr. Bebb married Anna E. Carpenter of Providence, Rhode Island, who became the mother of four sons and two daughters. She was a graduate of Mount Holyoke Seminary, in Massachusetts, and a daughter of Edmund and Lemira Carpenter whose parents were prominent during the Revolution. A few weeks after their marriage they left Washington and went to Illinois. Mr. Bebb's father, being at this time in Washington and not desiring to return to Fountaindale, had offered the estate for sale, and Mr. Bebb, who had always longed to realize the ideal life of a country gentleman, bought the old homestead with its acres of rich prairie land. Financially the undertaking was not a success, and in 1873 he thought seriously of selling the place, owing to the "large influx into the west of a foreign population and consequent overproduction of farm staples" which had destroyed farming except for those willing to work with their own hands for small returns. His pecuniary affairs, however, took a turn for the better soon after, and he decided to remain where he was. Still his life in Fountaindale was a checkered one. He was forced to contend against every discouragement for many years in the midst of his ardent pursuit of botany. During this time and afterwards, when his health began to fail, in all his labors on the farm and among his plants, in all his triumphs and in all his disappointments, he was ever sustained and encouraged by the constant devotion and ready self-sacrifice of his wife. She cheerfully and lovingly took upon her-

self almost the entire care of the household, brought up a family of nine children, and yet found time to take a deep interest in her husband's botanical work and be his constant aid. To her is largely due the success which he attained as an eminent salicologist.

It was about the year 1873 that Mr. Bebb gave himself up to the special study of willows. He had shown a growing interest in this subject for some years, and at this time was corresponding with Rev. J. E. Leefe, the British authority on Salix. Even as far back as February, 1861, he wrote "Salix is my pet genus if I have any special preference." No decided inclination, however, was shown in this direction till now. It is interesting to note the circumstance that led him to devote himself heart and soul to this group. He tells the story briefly in his own fascinating words. "Within gunshot of the house was a charming bit of lowland prairie upon which flourished the most diversified wild growth of willows I ever saw or heard of—my school in the study of this genus." This lay along a creek and was entirely undisturbed by cultivation. Mr. Bebb guarded it with jealous care, and in this school, with nature for a teacher, he learned how to unravel many a knotty problem. He soon became an authority, and in 1874 he was asked by Dr. Asa Gray to contribute the Salices to Brewer and Watson's Botany of California. It was in this year that he published in the *American Naturalist* his first paper on willows, entitled "A new species of willow (S. laevigata) from California, and notes on some other North American species."

In a letter to Dr. Gray, dated January 3, 1873, Mr. Bebb speaks of his longing for spring that he might set out his salicetum. This plantation of willows grew to large proportions and was of the greatest value to him in his studies. It covered an extent of two acres and was composed, Mrs. Bebb says, "of rare and varying forms of our native willows, which were sent to him by correspondents, and also a fine collection of European willows sent by Dr. Hooker from Kew." The labor and care expended in collecting, planting and tending this willow garden can hardly be overestimated. In May, 1873, he writes that of one thousand cuttings sent him from Kew all came up successfully.

It was in 1858 that he laid the foundation of his herbarium, and by 1873 it had assumed very large proportions. It con-

sisted of about 15,000 species, illustrated by over 30,000 specimens. For fifteen years he had enjoyed a liberal exchange with the best collectors, and his special effort had been to illustrate the Gray Manual Flora, each species showing, as far as possible, flower, fruit and root, with marked varieties and geographical range. Besides these he had valuable additions from Europe and Southern Africa, and all these specimens he mounted himself with loving care. The specimens of his own collecting were of the finest quality, and were always an object of admiration to those who possessed them. He still carried on his wide botanical correspondence, and in 1878 he began to publish in the BOTANICAL GAZETTE various notes on willows, and this he continued to do till 1891. These consisted of six papers, entitled "Notes on North American willows," besides special observations on individual species. In this same year, 1878, he published the willows in Rothrock's Botany of the Wheeler Report, and in 1880 appeared his work on the willows in the Botany of California. In 1880 Nils J. Andersson, the eminent Swedish authority on the genus Salix, died, and Mr. Bebb stood without a rival at home or abroad. Every important collection of willows made in this country passed through his hands for determination, and not the least valuable portion of the work left behind him are these plants authentically named and scattered through the leading herbaria both here and in Europe.

Life in Fountaindale, however, at last came to an end, and in October, 1879, the family moved to Rockford, Ill. They still continued to visit the old home during the summer months, but, a few years later they sold the place, where Mr. Bebb had lived so long and had done so much valuable work on the willows, that the very words willow and Fountaindale will always be associated with each other. A practical farmer bought the estate, and truly did Mr. Bebb mourn the fate of his beloved garden. The wild growth of willows, his school in the study of that genus, "was speedily grubbed, drained and seeded down," he relates sadly. "The plantation of willows, which had cost me so much in care and outlay, was seized as a capital place to feed steers, and enclosed by a high board fence. The teams drove along between the rows. The fodder was thrown off on the bushes, and the cattle followed, eating at their leisure, with an occasional bite of bitter willow for tonic and stimulant." Even in times of deep distress he could show his fine sense of humor.

During the first few years of his life in Rockford, Mr. Bebb was as active as ever in his botanical pursuits, and in 1880 he attended the meeting of the American Association for the Advancement of Science at Portland, Maine. He had been present at the meeting of this society in 1872, at Dubuque, Iowa. In the winter of 1880 and 1881 he issued his first fascicle of Salices. These consisted mainly of specimens from plants either growing naturally at Fountaindale or set out in his willow plantation. Any herbarium is rich that possesses this collection. His skill as a draughtsman is shown in the beautiful drawings that accompany the plants. Mr. Bebb fully intended and hoped to issue a second fascicle, and he often referred to it in his letters, but various circumstances, combined with ill health, unfortunately prevented. In the autumn of 1885 he was seized with a severe attack of pleurisy and he never after regained perfect health. His interest in botanical subjects was still unabated, and he was enabled to accomplish much valuable work. He published in the *Bulletin* of the Torrey Botanical Club, between 1888 and 1890, four series of "Notes on the White Mountain willows," and in 1890 he contributed the Salices to the sixth edition of Gray's Manual. His correspondence from this time until his death is full of the charm of a graceful letter writer. He was always interested in all the questions of the day as well as in all branches of science. At one time he pursued with great zeal the study of conchology and made quite a collection of shells, and he acquired a good knowledge of entomology and geology, fully realizing the importance of their bearing on the study of plants.

Mr. Bebb was of a retiring nature, and most of his time in Rockford was spent in the privacy of his family. To his familiar correspondents his letters were always full of charming pictures of home scenes, and by many he will be affectionately remembered not as the botanist merely, but as a loving and devoted father. During a great deal of this time he was well enough to enjoy heartily the various festivities that the years brought round, and I cannot forbear giving his account of a Christmas scene in December, 1889. "From early morn when the youngsters came tumbling down stairs before it was yet light to explore the depths of their stockings, until late in the evening when the last member of the family put out the lights and went, rather tired withal, to bed, we had one of

just the merriest, happiest Christmases imaginable. Not a ripple of discontent to mar the enjoyment of the family festivity. The children were hilarious and the old folk serenely content. The demon of misfit, who stalks abroad at this season, overcoming some good, kindly, well-intentioned souls, happily brought not a single one of our friends under his baleful spell. On the contrary, many a little gift was rendered thrice welcome, because it at once recalled some wish expressed months ago and forgotten, save as loving remembrance on the part of others carried it on to the joyous season of good-will to all."

Adjoining his house was a small garden, and this was always his great delight. He worked in it constantly and kept it well supplied with hardy shrubs and perennials, many of which he secured from the Arnold Arboretum. His herbarium which is estimated to contain about 50,000 specimens, besides the willows, was still his constant thought. Though during his life in Rockford he was unable to add much to his general collection, he kept up his Salix herbarium to the very last. His willows filled two walnut cabinets, about three by five feet in dimensions, and these he kept apart from his other plants, and close at hand for ready use.

He was a member of the Philadelphia, Buffalo, and Chicago Academies of Science, and was complimented by having several plants named in his honor. In 1885 Prof. E. L. Greene published in the *Bulletin* of the California Academy of Science the genus *Bebbia*, native to Southern California and Arizona, with the following inscription: "The genus is dedicated to Mr. Michael S. Bebb of Rockford, Ill., an able botanist to whom all students of the science on the Pacific coast are indebted for the careful elaboration of our species of the difficult genus *Salix* in the second volume of the Botany of California." In 1889 Prof. L. H. Bailey created the variety, *Carex tribuloides* Wahl. var. *Bebbii*, common to the Gray's Manual region, and in 1895, Prof. C. S. Sargent published, in *Garden and Forest*, *Salix Bebbiana*, a species of northern North America, inscribing it to Mr. Bebb, "the learned, industrious and distinguished salicologist of the United States to whom, more than to any one else of this generation we owe our knowledge of American willows."

Though naturally shrinking from public notice, Mr. Bebb did his share as a faithful citizen of Rockford. For eight

years he was a member of the school board and he assisted largely by his energy and wisdom in raising the public schools to their present high standard. For eight years he served on the library board. In 1888 he bought a piece of land in southern Wisconsin on the shore of the Lauderdale lakes and built a small house, where for eight successive years the family spent their summers in rest and retirement. In this way Mr. Bebb avoided the summer heat and there he did some of his best work on the willows. He built with his own hands a lapstreak boat large enough to take all the family, and he was never tired of being rowed about over the clear water. August 9, 1888, he writes, "At the extreme west end of Middle lake are a number of immense springs probably the outlet of some subterranean communication with other bodies of water. They vary from ten to one hundred feet in depth, and to float over them in a boat gives one a strange impression, as if suspended in mid-air. The water is beautifully clear and slightly impregnated with sulphur. Down the sides of the bowl-shaped springs the banks are covered with an aquatic growth of fresh-water algæ of an intense emerald green, through which run sharply defined streaks of an intense purple or amethystine color, probably also a vegetable growth. At the bottom the water rises through clear white sand." Such descriptions as these show the delicately refined nature of the man.

Each year he found it harder to endure the rigorous winters of northern Illinois, and in January, 1893, he went alone to Demorest, Georgia, where he stayed between two and three months. His letters from this place are full of beautiful accounts of the scenery about him. He even felt able to do some salix work, for he contemplated a monograph of the North American willows, embodying the results of his many years of study. In January, 1894, he went to Clearwater Harbor, Florida. He enjoyed his stay there for three months and, before returning home, spent two weeks in Demorest. His last trip south was with his wife in January, 1895. They kept house for three months in Demorest, but unexpected cold weather rendered this visit unsuccessful, and Mr. Bebb was glad to get home.

In June, 1895, he published the willows of the Peary Auxiliary Expedition in *Bulletin V* of the Geographical Club of Philadelphia. With this exception he had not published any-

thing since 1891. His last contributions to the subject were now soon to follow. He devoted himself to work with a good deal of energy in the summer of 1895 toward finishing some notes which he had promised to *Garden and Forest*, and near the close of the year he published in these columns five series of "Notes on some arborescent willows." Mr. Bebb assisted in the forth-coming volume of Sargent's Silva by selecting the material from which Mr. Charles E. Faxon drew the willow plates, and by criticising the sketches which were all submitted to him.

During the past year, however, consumption had set in and his strength was failing fast. His summer at Lauderdale had brought no improvement, and it was decided to pass the winter in San Bernardino, California. He started with Mrs. Bebb November 2d, full of courage and hope, and he even formed plans of going on with the task which he had at heart. He was not able, however, to touch any botanical work, but constantly grew weaker. Mr. and Mrs. Samuel B. Parish were unremitting in their kind attentions and helped to brighten the last moments of the sick man. At last on the morning of December 5, 1895, Mr. Bebb passed quietly away surrounded by his wife and loving friends. The funeral took place at the family home at Rockford on December 13th. Dr. Thomas Kerr, his pastor, conducted the ceremony and spoke beautifully of Mr. Bebb's life and work. His six sons bore him from the house, and he was laid to rest in the West Side cemetery in the city.

Though Mr. Bebb was not allowed to finish his long cherished work, the revision of the willows for the Flora of North America, still he has left invaluable material relating to the subject, besides his salix herbarium containing the collections of years and enriched by his own notes and drawings. All this will be the basis of future work. Mr. Bebb by his character and ability honored the science with which he was so long identified, and he will always be remembered as a botanist of the highest rank.

Cambridge, Mass.

BIBLIOGRAPHY.

List of plants occurring in the northern counties of the state of Illinois, in addition to the catalogue given by Dr. I. A. Lapham. Trans. Ill. Agric. Soc. **3**: 586–587. 1859.

A new species of willow (S. laevigata) from California, and notes on some other North American species. Am. Nat. **8**: 202–203. 1874.

How to apply pressure in making botanical specimens. Bot. Gaz. **1**: 21. 1876.

Salix Barclayi Anders. a native of the northern states. Bot. Gaz. **3**: 21. 1878.

Salices. In Rothrock's Botany of the Wheeler Report 240–242. 1878.

Salix balsamifera Barratt, *S. cordata*, var. *balsamifera* Hook., an older name for *S. pyrifolia* Anders. Bot. Gaz. **4**: 190–192. 1879.

Salices. In Watson, Bot. Calif. **2**: 82–90. 1880.

Systematic botany nevertheless (*pseud.* Emesby). Bot. Gaz. **6**: 298–300. 1881.

Note on *Salix Sitchensis* and its affinities. Bot. Gaz. **7**: 25–26. 1882.

A note from Emesby (*pseud.* Emesby). Bot. Gaz. **7**: 27–30. 1882.

Recently introduced plants in and about Rockford, Ill. Bot. Gaz. **7**: 68–70. 1882.

Salix flavescens Nutt., var. *Scouleriana*. Bot. Gaz. **7**: 129. 1882.

More about Rafinesque. Bot. Gaz. **8**: 191–192. 1883.

Some popular botany (*pseud.* A Countryman). Bot. Gaz. **8**: 209–210. 1883.

The willow basket. Bot. Gaz. **9**: 48. 1884.

Salices. In Coulter's Man. Rocky Mt. Reg. 334–339. 1885.

Salix macrocarpa Nutt., not of Andersson. Bot. Gaz. **10**: 221–223. 1885.

Willows (Salix). Bot. Gaz. **11**: 136–137. 1886.

On some mistaken estimates made by amateurs. Bot. Gaz. **13**: 63–64. 1888.

White Mountain willows. I–IV. Bull. Torr. Bot. Club.—I. l. c. **15**: 121–125. *pl. 81.* 1888.—II. l. c. **16**: 39–42. 1889.—III. l. c. **16**: 211–215. 1889.—IV. l. c. **17**: 149–151. 1890.

Notes on North American willows, I–VI. Botanical Gazette.—I. With a description of new or imperfectly known species. l. c. **13**: 109–112. 1888.—II. l. c. **13**: 186–187. *pl. 10.* 1888.—III. l. c. **14**: 49–54. *pl. 9.* 1889.—IV. l. c. **14**: 115–117. 1889.—V. l. c. **15**: 53–56. 1890.—VI. A review of the willows of California. l. c. **16**: 102–108. 1891.

Willow galls. Bull. Torr. Bot. Club. **16**: 22–23. 1889.

Some queer botany. Bot. Gaz. **14**: 136. 1889.

Salices. In Gray, Man. ed. 6, 480–486. 1890.

Mounting plants. Bot. Gaz. **16**: 121–122. 1891.

Salices. In Bull. Geogr. Club Philad. **1**: 212. 1895.

Notes on some arborescent willows of North America. I–V. Garden and Forest, **8**: 363, 364.–371, 373.–423. *figs. 57, 58.*–473.–482, 483. 1895.

Notes on our Hepaticæ. IV.

The genus Fossombronia.

LUCIEN M. UNDERWOOD.

Among the genera of the Jungermaniales the present genus is perhaps the only one in which the spore markings have been used as specific characters. The older hepaticologists failing to recognize these important characters failed in many instances to discriminate the species and in many of the earlier exsiccatæ the same name covers two or three species which are now clearly recognized by spore characters. Our own species have been indiscriminately referred to common European species and as this was done before the right recognition of species obtained there, we have a complicated tangle of misapplied names to unravel.

In order of sequence the following species have been referred to our flora by various authors.

1821. Schweinitz described[1] *Anthoceros jungermannioides* which is evidently a species of *Fossombronia* as first pointed out by Sullivant in 1845. While it probably represented *F. foveolata*, our most common species, there is no means at hand of verifying the supposition.

1845. Sullivant distributed[2] *Fossombronia pusilla*, from Mobile, Ala. As his specimens, at least in my set of the Musci Alleghanienses, are sterile, it is not possible to determine with certainty what species this is, the foliar characters not being sufficiently distinct to discriminate species properly.

1856. Sullivant again reported[3] *F. pusilla* from "moist places on the ground; mostly southern." His figure (the same that now appears in the sixth edition of Gray's Manual) does not even approximately represent the spores of any of our species. It is reasonably certain, however, that the species he has figured is really *F. foveolata*.

1869. Austin published[4] *F. cristula* from New Jersey and

[1] Spec. Fl. Am. Sept. 25. 1821.
[2] Musc. Alleg. *no.* 277. 1845.
[3] Mosses and Hepaticæ of the Eastern U. S. in Gray, Man. 691. 1856. (ed. 2.)
[4] Proc. Phila. Acad. 1869; 228. 1869.

Androcryphia longiseta from California and Texas, giving *F. longiseta* Aust. MS. as a synonym for the latter.

1872. Austin issued four species[5] as follows: *F. longiseta* no. 118, *F. angulosa*, no. 119, *F. pusilla*, no. 120, and *F. cristula*, no. 121.

1875. Lindberg in commenting on Austin's exsiccatæ[6] recognizes nos. 118 and 121 as good species, the former allied to *F. cristata* and the latter to *F. foveolata* of Europe. With no. 118, he says, a second species occurs (the Texas specimens) which he briefly characterizes under a name (*F. Texana* Lindb. MS.). No. 119 he asserts is not *F. angulosa* as known in Europe, and he briefly characterizes the sterile specimens under the MS. name of *F. salina* Lindb. No. 120 he refers doubtfully to *F. foveolata* but later[7] refers it to this species with more positiveness.

1876. Austin described[8] *F. Macouni* from Canada (Portage La Lochs, lat. 57°), and *F. Wrightii* from Cuba (the latter based on material distributed later in Hep. Cubenses Wrightianæ as "*F. pusilla*"), and briefly characterized the Texan specimens (originally included in *F. longiseta* and named *F. Texana* by Lindberg) under the name of *F. Cubana* (Gott.) Aust., including with them material collected in Cuba by Charles Wright which had been named by Gottsche and were afterwards distributed in Hep. Cubenses Wrightianæ as "*F. pusilla*, var. *Cubana* G."

The above species represent all the material that was known to me when the compilation was made for my descriptive catalogue of species.[9] It is fair to state that at the time of publication of that paper Lindberg's publication noted above was not known to me.

1889. Underwood and Cook issued[10] specimens of *F. Dumortieri*[11] as no. 47. This species had previously been cited

[5] Hepaticæ Boreali-Americanæ.

[6] Hepaticæ in Hiberniæ lectæ. Acta Soc. Scien. Fenn. **10:** 533. 1875.

[7] Rev. Bryol. **12:** 39. 1885.

[8] Bot. Bulletin (now Bot. Gazette) **1:** 36. 1876.

[9] Bull. Ill. State Lab. Nat. Hist. 2: 1–133. 1884.

[10] Hepaticæ Americanæ, dec. V–VI. N 1889.

[11] The name of this species here given cannot stand under the present rules of nomenclature as it was based on a *nomen nudum* and that issued in exsiccatæ. Lindberg's original name, therefore, must hold. The synonymy of the species is as follows:

FOSSOMBRONIA FOVEOLATA Lindb. 1873.

Codonia Dumortieri Hueb. et Genth. Deutschlands Lebermoose in getrockneten Exemplaren *no. 80.* 1837; name only.

Fossombronia Dumortieri Lindb. Not. pro F. et Fl. Fenn. **13:** 417. 1874.

as American by Lindberg (Drummond, Musc. Amer. II. no. 163 from Louisiana).

1892. Underwood reported[12] *F. cristata* from Indiana.

From a study of the herbarium material at hand we appear to have the following species:

1. F. ANGULOSA (Dicks.) Raddi. Mem. della Soc. Ital. di Mod. **18:** 40. 1818.

Cuba, *Wright;* Florida, *Underwood;* Alabama, *Underwood;* Texas, *Thurow.* The specimens issued in Hep. Amer. no. 118 differ from representative European specimens in shorter elaters and slightly larger spores, in both particulars varying in the direction of *F. foveolata.* They are apparently dioicous.

2. F. CRISTATA Lindb. "apud Soc. pro F. et Fl. fenn. die 6th Dec. 1873" Not. pro F. et Fl. fenn. **13:** 388. 1874.[13]

Indiana, *Underwood;* Ohio, *Werner.*

3. F. CRISTULA Aust. Proc. Phila. Acad. **1869:** 228. 1869.

New Jersey, *Austin;* Distributed in Hep. Bor.-Am. *no. 121.*

4. F. FOVEOLATA Lindb. "apud Soc. pro F. et Fl. fenn. die 6 Dec. 1873." Not. pro F. et Fl. fenn. **13:** 382. 1874.[13]

Maine, *Rand;* New Jersey, *Austin;* Delaware, *Commons, James;* Ontario, *Macoun, Britton;* British Columbia, *Macoun.* Sterile specimens from South Carolina, *Ravenel,* seem also to belong here as is also the case with various similar specimens in exsiccatæ.[14] Distributed in Hep. Amer. as *F. Dumortieri, no. 47.*

5. F. LONGISETA Aust. *as syn.* Proc. Phila. Acad. **1869:** 228. 1869.

Androcryphia longiseta Aust. l. c.

California, *Bolander, Brandegee, Farlow, Parish, Howe.* Distributed in Hep. Bor.-Am. *no. 118,* and in Hep. Amer. *no. 157.*

6. F. TEXANA Lindb. Acta Soc. Scien. fenn. **10:** 533. 1875.

[12] Proc. Ind. Acad. Science **1891:** 90. 1892.

[13] I have been unable to verify the earlier citations of Lindberg. The species are described in the second paper cited, with illustrations of the spores.

[14] E. g., Musc. Alleg. *no. 277.* Hep. Bor.-Am. *no. 120.* Canadian Hepat. *no. 64.*

F. Cubana (Gott.) Aust. Bot. Bulletin (now Bot. Gazette) **1**: 36. 1876.

F. pusilla, var. *Cubana* Gott., name only, in Hep. Cubenses Wrightianæ.

Cuba, *Wright;* Austin also reported it from Texas but I have no means of verifying the reference.

7. F. WRIGHTII Aust. Bot. Bulletin (now Bot. Gazette) **1**: 36. 1876.

Cuba, *Wright.*

SPECIES DUBIÆ.

8. F. PUSILLA (L.) Dumort. Recueil d'obs. sur les Jung. 11. 1835.[15]

This species so often alluded to in the above references must be placed in the doubtful list as we are unable to cite a single fertile plant from any part of North America.

9. F. SALINA Lindb. Acta Soc. Scien. fenn. **10:** 533. 1875.

F. angulosa Aust. Hep. Bor.-Am. *no. 119*, not Raddi.

This species founded on sterile specimens will have to be placed in the doubtful list unless fertile specimens can be found. It is unfortunate that it was ever given a name!

10. F. MACOUNI Aust. Bot. Bulletin (now Bot. Gazette) **1**:36. 1876.

"Portage La Lochs, lat. 57°, Macoun." I have seen no specimens of this species. Mr. Pearson writes me that no specimens exist in either of the parts of the Austin collection; nor does Mr. Macoun, its collector, possess any specimens.

In order to facilitate the determination of our species I append the following table with the more important characters emphasized.

**Spores clearly foveolate or reticulate.*

Elaters few or wanting; spores pale brown, 35–44μ; paroicous . . . . . *F. cristula.*

Elaters abundant; spores dark brown.

Dioicous; spores 35–40 with few reticulations; elaters 220–250μ . . . . . *F. angulosa.*

Heteroicous; spores 42–50μ with more numerous reticulations; elaters 120–135μ . . *F. foveolata.*

[15] Dumortier clearly intended to write "pusilla" at this reference, but by a singular typographical error he wrote "pumila" which happens to be also one of the species of the Linnaean genus Jungermania.

***Spores spinulose-cristate, the crests only occasionally anastomosing.*

Dioicous.

Spores 29–40μ; elaters 160–300μ . . *F. longiseta.*

Spores 50–60μ; elaters 135–200μ . . *F. Texana.*

Heteroicous; spores 29–40μ; elaters about 120μ. *F. cristata.*

****Spores verrucose*, 53–56μ; dioicous? . . *F. Wrightii.*

Having never seen *F. Macouni* I can only quote Austin's description of its spores: "*Sporis parviusculis subopacis densissime minutissime papillosis.*" It would doubtless fall in the table near *F. Wrightii.*

It is hoped that collectors will send in material illustrating more fully the distribution of this interesting genus. The species all grow in sandy or clayey soil, closely creeping, and for the most part produce their spores late in the season. I desire also that those who possess either Austin's Hep. Bor. Am. or Sullivant's Musc. Alleg. examine the species above noted for spores and report any modifications necessary in the statements. The spores of the European species have been figured in accessible works, *e. g.* Not. pro Fl. et Faun. Fenn **13:** *pl. 1.* and Rev. Bryol. **17:** *pl. 1.* These include *Ff. angulosa, foveolata, cristata,* and *pusilla* besides other species not found in America.

Auburn, Ala.

Flowers and insects. XV.[1]

CHARLES ROBERTSON.

POLYGONUM Tourn.—For the present I withhold the consideration of the mode of pollination and of the copious special literature and contribute lists of insect visitors of the two following species.

POLYGONUM PENNSYLVANICUM L.—The visitors observed on nine days between Aug. 8th and Sept. 16th, are as follows:

HYMENOPTERA—*Apidæ:* (1) Apis mellifica L. ♀, ab.; (2) Bombus separatus Cr. ♂; (3) B. americanorum F. ♂♀; (4) B. virginicus Oliv. ♂♀, ab.; (5) Megachile brevis Say ♂; *Andrenidæ:* (6) Andrena asteris Rob. ♂; (7) Agapostemon radiatus Say ♂; (8) Augochlora viridula Sm. ♀; (9) A. pura Say ♀; (10) Halictus fasciatus Nyl. ♀; (11) H. pilosus Sm. ♀; (12) H. confusus Sm. ♀; (13) H. stultus Cr. ♀; *Vespidæ:* (14) Polistes pallipes Lep.; (15) P. rubiginosus Lep.; (16) P. metricus Say; (17) P. annularis L.; *Eumenidæ:* (18) Odynerus tigris Sauss., freq.; (19) O. capra Sauss., freq.; *Crabronidæ:* (20) Crabro interruptus Lep.; (21) C. 6-maculatus Say; *Philanthidæ:* (22) Cerceris clypeata Dlb.; *Larridæ:* (23) Ancistromma distincta Sm.; *Sphecidæ:* (24) Ammophila intercepta Lep.; (25) Chlorion caeruleum Dru.; (26) Priononyx atrata Lep.; *Pompilidæ:* (27) Pompilus philadelphicus Lep.; (28) Priocnemis fulvicornis Cr.; (29) Planiceps niger Cr.; *Scoliidæ:* (30) Myzine sexcincta F.—all sucking.

DIPTERA—*Bombylidæ:* (31) Sparnopolius fulvus Wd.; *Syrphidæ:* (32) Syrphus ribesii L.; (33) S. americanus Wd., freq.; (34) Mesograpta polita Say; (35) M. marginata Say; (36) Eristalis tenax L.; (37) E. aeneus F.; (38) Tropidia quadrata Say; (39) Syritta pipiens L.; *Tachinidæ:* (40) Cistogaster immaculata Mcq.; (41) Jurinia smaragdina Mcq., ab.; (42) J. apicifera Wlk.; (43) Micropalpus fulgens Mg.; (44) Frontina acroglossoides Twns.; (45) F. flavicauda Riley; (46) Atrophopoda singularis Twns.; *Sarcophagidæ:* (47, 48) Sarcophaga spp.; *Muscidæ:* (49) Graphomyia sp., freq.; (50) Lucilia caesar L.; (51) L. cornicina F.; (52) Compsomyia macellaria F.—all sucking.

LEPIDOPTERA — *Rhopalocera:* (53) Pieris protodice B.-L.; (54) P. rapæ L.; (55) Colias philodice Gdt.; (56) Chrysophanus thoe B.-L.; (57) Pamphila cernes B.-L.; *Heterocera:* (58) Heliothis armiger Hüb.; (59) Scepsis fulvicollis Hüb.—all sucking.

COLEOPTERA — *Lampyridæ:* (60) Chauliognathus pennsylvanicus DeG., s., ab.

POLYGONUM HYDROPIPEROIDES Michx.—The following visitors were observed Aug. 30th and Sept. 20th:

[1]Contributions to an account of the ecological relations of the entomophilous flora and the anthophilous insect fauna of the neighborhood of Carlinville, Illinois.

HYMENOPTERA—*Apidæ:* (1) Apis mellifica L., ☿; (2) Ceratina dupla Say ♀; (3) Megachile brevis Say ♂; (4) M. mendica Cr. ♀; *Andrenidæ:* (5) Andrena solidaginis Rob. ♀; (6) Agapostemon radiatus Say ♂♀; (7) Halictus coriaceus Sm. ♂, freq.; (8) H. lerouxii Lep. ♀; (9) H. fasciatus Nyl. ♀; (10) Colletes armata Pttn. ♂; (11) C. eulophi Rob. ♂; (12) C. americana Cr. ♂♀, freq.; (13) C. latitarsis Rob. ♀; (14) Prosopis pygmaea Cr. ♂; *Vespidæ:* (15) Polistes pallipes Lep.; (16) P. metricus Say; *Eumenidæ:* (17) Odynerus capra Sauss.; (18) O. dorsalis F.; (19) O. arvensis Sauss.; *Crabronidæ:* (20) Crabro texanus Cr.; (21) C. trifasciatus Say; (22) Thyreopus tumidus Pack.; (23) Anacrabro ocellatus Pack.; (24) Oxybelus 4-notatus Say; (25) O. emarginatus Say; *Philanthidæ:* (26) Philanthus ventilabris F.; (27) P. punctatus Say; (28) Eucerceris zonatus Say: (29) Cerceris fumipennis Say; (30) C. kennicottii Cr.; *Nyssonidæ:* (31) Gorytes phaleratus Say; *Larridæ:* (32) Astata bicolor Say; (33) Ancistromma distincta Sm.; (34) Tachytes aurulentus F.; *Sphecidæ:* (35) Pelopoeus cementarius Dru.; (36) Isodontia philadelphica Lep.; (37) Sphex ichneumonea L.; (38) Prononyx thomæ F.; (39) P. atrata Lep.; *Pompilidæ:* (40) Pompilus philadelphicus Lep.; (41) P. algidus Sm.; (42) P. biguttatus F.; (43) P. navus Cr.; (44) Ceropales fraterna Sm.; *Scoliidæ:* (45) Tiphia tarda Say; (46) Myzine sexcincta F.; *Mutillidæ:* (47) Sphaerophthalma macra Cr.; *Chrysididæ:* (48) Holopyga ventralis Say; (49) Hedychrum wiltii Cr.; (50) H. violaceum Brullé; (51) Chrysis texana Grib.; (52) C. nitidula F.

DIPTERA—*Bombylidæ* (53) Systoechus vulgaris Lw.; *Conopidæ:* (54) Conops brachyrrhynchus Mcq.; *Syrphidæ:* (55) Paragus tibialis Fll.; (56) Eristalis bastardi Mcq.; (57) E. flavipes Wlk.; (58) Tropidia quadrata Say; (59) Syritta pipiens L.; *Tachinidæ:* (60) Jurinia apicifera Wlk.; (61) Frontina acroglossoides Twns.; *Sarcophagidæ:* (62–64) Sarcophaga spp.; *Muscidæ:* (65) Lucilia caesar L.; (66) L. cornicina F.; (67) Compsomyia macellaria F.; *Anthomyidæ:* (68) Coenosia sp.

COLEOPTERA—*Coccinellidæ:* (69) Coccinella 9-notata Hbst.; *Lampyridæ:* (70) Chauliognathus pennsylvanicus DeG.; *Chrysomelidæ:* (71) Disonycha limbicollis Lec. v. pallipes Cr.; *Curculionidæ:* (72) Listronotus caudatus Say.

DIRCA PALUSTRIS L.—This is a low shrub blooming quite early, March 18th to April 13th, and bearing small greenish yellow flowers which appear before the leaves. At the ends of the branchlets are situated buds of about four hairy scales enclosing, in cases observed by me, three flower-buds and a leaf-bud. The flowers are pendulous and are sheltered by the bud scales which form a hood above them.

The calyx tube is about 5^{mm} long and is truncate, with obscure lobes. The bottom of the tube is completely filled by the ovary so that with a proboscis 4^{mm} long a bee may obtain all the nectar, which I think is secreted by the tube. For the distance of about 1^{mm} from the ovary to the point where the stamens are inserted the tube is narrow. Above that point it is wider but is obstructed by the eight filaments and the

style. The anthers are exserted about 2^{mm} beyond the mouth of the tube, the alternate ones being somewhat shorter. The stigma is advanced about 2^{mm} further.

In a bud which had just begun to open I found that the flowers had the anthers reaching just to the mouth, but the stigmas advanced 2^{mm} beyond. The anthers were closed but the stigmas were receptive. There was thus an appearance of proterogyny, but it must be short-lived, for all of the other flowers which I observed had the anthers dehiscent, the larger ones, however, shedding their pollen first. The arrangement for cross-pollination is the simple one, common in pendulous flowers, of the stigma being in advance of the anthers. Pollination between flowers of the same plant may occur, but I think there is little chance of self-pollination.

As noted above, the calyx has obscure lobes, and my examination of early cases, in which the open mouths of the tubes were crowded with the swollen anthers, leads me to believe that the abortion of the lobes is correlated with the fact that the young flowers are protected by the scales which form the common envelope of the leaf-bud and the flower cluster.

The pendulous position of the flowers, the comparatively deep, narrow tube, and the early blooming time convince me that the flowers are adapted to the smaller bees. The following list of visitors, observed March 21st, confirms this view:

HYMENOPTERA—*Apidæ:* (1) Ceratina dupla Say ♂; (2) C. tejonensis Cr. ♂: (3) Osmia lignaria Say ♂; (4) Nomada maculata Cr. ♂; *Andrenidæ:* (5) Halictus sp. ♀; (6) H. zephyrus Sm. ♀; (7) H. confusus Sm. ♀; (8) Augochlora labrosa Say ♀; (9) Andrena rugosa Rob. ♂; (10) Colletes inaequalis Say ♂—all s.

LEPIDOPTERA—*Nymphalidæ:* (11) Vanessa antiopa L., s.

EUPHORBIA L.—As in the case of *Polygonum*, I omit remarks upon the mode of pollination and references to the literature.

EUPHORBIA COROLLATA L.—The stems grow from 6 to 10^{dm} high and are terminated by large umbel-like clusters with white involucres which make it the most conspicuous of our Euphorbias.

It was observed in bloom from May 24th to Sept. 27th. The following list, consisting mainly of flies, on which the plant seems to depend, with the exception of no. 1, was observed on July 25th:

DIPTERA—*Bombylidæ:* (1) Anthrax alternata Say; *Syrhpidæ:* (2) Paragus tibialis Fll.; (3) P. bicolor F.; (4) Pipiza pulchella Will.; (5) Chrysogaster nitida Wd.; (6) Allograpta obliqua Say; (7) Spaerophoria cylindrica Say; (8) Syritta pipiens L.; *Tachinidæ:* (9) Cistogaster immaculata Mcq.; (10) Miltogramma argentifrons Twns.; *Muscidæ:* (11) Lucilia cornicina F.; (12) Cyrtoneura sp.

HYMENOPTERA—*Andrenidæ:* (13) Prosopsis pygmaea Cr. ♀; *Pompilidæ*: (14)Pompilus relativus Fox.—all sucking.

HEMIPTERA—*Coreidæ:* (15) Chariesterus antennator F., s.

SALIX Tourn.—The flowers of willows are dioecious and entomophilous, but Warming (21) regards *S. herbacea* and some other species as anemophilous in Greenland. In the Alps, according to Müller (15), *S. herbacea* secretes abundant nectar and is visited by insects. Kerner (24) observed some species to be proterogynous, with the result that at first they could only receive pollen from flowers of other species and consequently produced hybrids.

Sprengel (1) regarded the staminate catkins as being more conspicuous than the pistillate in order that the latter might thus be more likely to be visited by insects which had first become dusted with pollen from the staminate flowers. While it is a fact that the staminate catkins are more attractive to insects, and, in spite of Bonnier's (11) statements to the contrary, are more abundantly visited by them, it can hardly be maintained that the increased conspicuousness was developed on this account, for, as claimed by MacLeod (27), the staminate flowers of anemophilous plants are also more conspicuous than the others. I have often noticed that the catkins of *Populus monilifera* were quite red or yellow, making them more brightly colored than in any of our species of *Salix*.

From their readily accessible nectar and exposed pollen, the catkins are especially attractive to the less specialized bees (*Andrenidæ*) and to the flower flies (*Syrphidæ*) and in most of the cases given in the table these are the most abundant guests, together forming a majority of all the visitors. Except for the services of these insects there seems to be little reason why the flowers should bloom early, for all of the other insect groups, except the *Empidæ*, have more species later in the season. I suspect that, whenever a satisfactory list of visitors of a willow is made out, it will show a preponderance of *Andrenidæ* and *Syrphidæ*, unless there is some peculiarity in the insect fauna of the region.

The following table gives the results of observations made

in different regions in cases in which the insects have been identified:

Salix.	Region.	Observer.	Andrenidæ and Syrphidæ.	Other insects.	Other Hymenoptera.	Apidæ.	Andrenidæ.	Syrphidæ.	Other Diptera.	Other insects.
cordata	Illinois ...	.....	49	38	7	8	28	21	18	5
humilis	Illinois ...	.....	27	24	5	3	20	7	9	7
cinerea ... caprea .... aurita	Germany..	Müller (6, 12, 17)..	61	52	9	19	44	17	16	8
cinerea	Germany..	Loew (20).....	1	1	....	1	1	..	....	....
caprea	Germany..	Loew (28).....	11	5	....	4	11	..	1	....
aurita.....	Germany .	Loew (20, 28).....	1	2	....	1	..	1	1	....
nigricans ...	Germany..	Loew (20).....	1	1	....	1	1	..	....	....
alba.....	Germany..	Loew (28).....	....	1	....	..	..	..	1	....
amygdalina..	Germany..	Loew (28).....	1	....	....	..	1	..	....	....
amygdalina..	Germany..	Müller (12).....	2	3	....	1	2	..	2	....
fragilis	Germany..	Müller (12).....	2	4	1	1	2	..	....	2
repens	Germany..	Müller (6, 17)	4	6	1	2	4	..	2	1
repens	Norderney	Verhoeff (26)	7	26	2	4	1	6	14	6
Early spp ...	Flanders..	Mac Leod (27)....	15	28	5	6	12	3	15	2
Late spp	Flanders..	Mac Leod (27)....	7	5	....	1	3	4	4	....
herbacea	Alps.....	Müller (15, 17)....	....	2	....	..	..	..	1	1
reticulata ...	Alps.....	Müller (15).....	....	1	....	..	..	..	....	1
retusa	Alps.....	Müller (15).....	....	1	1	..	..	..	....	....

Those species which bloom before the leaves appear—as in the two following cases—are more abundantly visited because they have fewer competitors, and because their flowers are less concealed by the leaves.

Salix cordata Muhl. blooms from March 18th to April 23d. On April 9–11th, 14th, 17th, 18th, and 20th the following insects were taken on the flowers:

Hymenoptera—*Apidæ:* (1) Ceratina dupla Say ♂, s., freq.; (2) Osmia lignaria Say ♂, s.; (3) Nomada sayi Rob. ♂♀, s., very ab.; (4) N. maculata Cr. ♂♀, s.,very ab.; (5) N. luteola Lep. ♂♀ s., ab.; (6) N. luteoloides Rob. ♂, s.; (7) N. articulata Sm. ♂, s.; (8) N. integra Rob. ♂♀, s., ab.; *Andrenidæ:* (9) Andrena erythrogaster Ashm. ♂♀, s., and c. p., ab., in cop.; (10) A. sayi Rob. ♂♀, s., ab.. in cop.; (11) A. salicis Rob. ♂♀, s. and c. p.; (12) A. illinoensis Rob. ♂♀, s. and c. p., ab., in cop.; (13) A. flavo-clypeata Sm. ♂♀, s., ab., in cop.; (14) A. cressonii Rob. ♂, s., ab.; (15) A. nuda Rob. ♀, s.; (16) A. rugosa Rob. ♂♀, s.; (17) A. erythronii Rob. ♂, s.; (18) A. forbesii Rob. ♀, s.; (19) A. hippotes Rob. ♂, s.; (20) A. mariæ Rob. ♂♀, s. and c. p., ab.: in cop.; (21) A. claytoniæ Rob. ♂♀, s., ab.; (22) A. mandibularis Rob. ♂, s.; (23) A. pruni Rob. ♂; (24) Panurgus? andrenoides

Cr. ♂♀, s., very ab., in cop.; (25) Agapostemon radiatus Say ♀, s.; (26) Augochlora similis Rob. ♀, s.; (27) A. pura Say ♀, s.; (28) Halictus foxii Rob. ♀, s., ab.: (29) H. forbesii Rob. ♀, s., (30) H. lerouxii Lep. ♀, s., freq.; (31) H. pilosus Sm. ♀, s., freq.; (32) H. zephryus Sm. ♀, s.; (33) H. confusus Sm. ♀, s.; (34) H. stultus Cr. ♀, s.; (35) Sphecodes arvensis Pttn. ♀, s.; (36) Colletes inaequalis Say ♂, s.; *Vespidæ:* (37) Polistes rubiginosus Lep., s.; *Pompilidæ:* (38) Priocnemis conicus Say, s.; *Ichneumonidæ:* (39) Pimpla sp.; *Tenthredinidæ:* (40) Nematus vertebratus Say; (41) N. luteotergum Nort.; (42) Dolerus arvensis Say, s., ab.; (43) D. bicolor Bv., s., freq.

DIPTERA—*Simulidæ:* (44) Simulium sp. s.; *Empidæ:* (45) Empis otiosa Coq., s.; (46) Rhamphomyia gilvipilosa Coq., s.; *Conopidæ:* (47) Myopa vesiculosa Say, s.; (48) M. pilosa Will.; *Syrphidæ:* (49) Psilota buccata Mcq.; (50) Chrysogaster pictipennis Will., ab.; (51) Chilosia sp.; (52) Melanostoma obscurum Say; (53) Platychirus hyperboreus Staeg.; (54) P. quadratus Say, freq.; (55) Syrphus ribesii L.; (56) S. americanus Wd., ab.; (57) Sphaerophoria cylindrica Say; (58) Chalcomyia aerea Lw.; (59) Brachyopa vacua O. S.; (60) Eristalis aeneus F., ab.; (61) E. dimidiatus Wd., ab.; (62) E. transversus Wd.; (63) E. flavipes Wlk.; (64) Helophilus similis Mcq., ab.; (65) Tropidia mamillata Lw.; (66) Brachypalpus rileyi Will., ab.; (67) B. frontosus Lw., very ab.; (68) Xylota fraudulosa Lw., ab.; (69) Syritta pipiens L.; *Tachinidæ:* (70) Gonia frontosa Say, ab.; (71) G. exul Will.; *Sarcophagidæ:* (72) Cynomyia sp., ab.; *Muscidæ:* (73) Lucilia cornicina F., ab.; *Anthomyidæ:* (74) Chortophila sp.; *Cordyluridæ:* (75) Scatophaga squalida Mg., ab.; *Sciomyzidæ:* (76) Tetanocera sp.; (77) T. pictipes Lw.; *Lonchaeidæ:* (78) Lonchaea sp.; (79) L. polita Say; *Sepsidæ:* (80) Sepsis sp.; *Oscinidæ:* (81) Oscinis sp.; *M. acalyptratæ:* (82) sp.—all s. or f. p.

COLEOPTERA—*Chrysomelidæ:* (83) Orsodachna atra Ahr., ab.; (84) Lina lapponica L., ab.; (85) Galeruca tuberculata Say, freq.; *Oedemeridæ:* (86) Asclera puncticollis Say, freq.—all s. or f. p.

HEMIPTERA—*Capsidæ:* (87) Lygus pratensis L. s.

SALIX HUMILIS Marsh.—This species was observed in bloom from the 18th of March to the 21st of April. On March 18th and April 6–12th, 14th, 17th, 20th and 21st the following visitors were noted:

HYMENOPTERA—*Apidæ:* (1)Apis mellifica L. ☿, s. and c. p., ab.; (2) Bombus virginicus Oliv. ♀; (3) Ceratina dupla Say ♂, freq.; *Andrenidæ:* (4) Andrena vicina Sm. ♂♀, ab.; (5) A. erythrogaster Ashm ♂; (6) A. salicis Rob. ♂♀, s., freq.; (7) A. illinoensis Rob. ♂; (8) A. erythronii Rob. ♂♀; (9) A. cressonii Rob. ♂; (10) A. flavo-clypeata Sm. ♂; (11) A. rugosa Rob. ♂; (12) A. forbesii Rob. ♀; (13) Agapostemon radiatus Say ♀; (14) Augochlora pura Say ♀; (15) Halictus arcuatus Rob. ♀; (16) H. forbesii Rob. ♀; (17) H. coriaceus Sm. ♀; (18) H. lerouxii Lep. ♀, ab.; (19) H. fasciatus Nyl. ♀; (20) H. confusus Sm. ♀; (21) H. pruinosus Rob. ♀; (22) Sphecodes arvensis Pttn. ♀; (23) Colletes inaequalis Say ♂♀, ab.; *Ichneumonidæ:* (24) Ichneumon funestus Cr.; (25) Colpognathus helvus Cr.: *Tenthredinidæ:* (26) Dolerus arvensis Say, ab.; (27) D. bicolor Br., ab.; (28) D. sericeus Say—all s.

DIPTERA—*Syrphidæ:* (29) Syrphus americanus Wd.; (30) Sphaerophoria cylindrica Say; (31) Eristalis aeneus F.; (32) E. dimidiatus Wd.,

ab.; (33) E. latifrons Lw.; (34) Helophilus similis Mcq., ab.; (35) Brachypalpus frontosus Lw., ab., *Tachinidæ:* (36) Gonia frontosa Say, ab.; *Sarcophagidæ:* (37) Cynomyia sp., ab.; *Muscidæ:* (38) Lucilia caesar L.; (39) Lucilia cornicina F., ab.; *Anthomyidæ:* (40–41) Chortophila spp.; (42) Hyetodosia 4-notata Mg.; *Cordyluridæ:* (43) Scatophaga squalida Mg., ab.; *Sepsidæ:* (44) Sepsis sp., ab.—all s.

COLEOPTERA—*Coccinellidæ:* (45) Hippodamia parenthesis Say; *Lampyridæ:* (46) Ellychnia corrusca L.; *Chrysomelidæ:* (47) Orsodachna atra Ahr., ab.—all s.

HEMIPTERA—*Lygaeidæ:* (48) Lygaeus turcicus F.; *Pentatomidæ:* (49) Euschistus variolaris P. B. (det. by Uhler); *Capsidæ:* (50) Lygus pratensis L.—all s.

LEPIDOPTERA—*Rhopalocera:* (51) Vanessa antiopa L., s.

The staminate flowers are so thoroughly monopolized by hive-bees that other insects are almost entirely absent. Accordingly, most of the insects in the list were taken on the pistillate flowers which they visited only for nectar.

On the literature of *Salix* see:

(1) Sprengel, Das entdeckte Geheimniss 31. 437–8. 1793. *S. caprea* visitors, etc.—(2) Hildebrand, Geschlechter-vertheilung bei den Pflanzen 9. 12. 1867. Diclinism.—(3) Axell, Om anordningarna för de fanerogama växternas befruktning 47, 62, 93, 113. 1869. *S. pentandra, cinerea, nigricans.*—(4) White, Winter fertilization by agency of insects. Journ. Bot. N. S. **1**: 48, F 1872. Visitors of ♂ and ♀ fls.—(5) Delpino, Ulteriori osservazioni Pt. II. fasc. 2: (154). 1875. Atti d. Soc. Ital. d. Sci. Nat. in Milano. **16**: 302. 1873. Lit. (1) and (4).—(6) Müller, Befruchtung der Blumen 149–50. 1873.—(7) Kerner, Die Schutzmittel des Pollens 50. 1873.—(8) Kerner, Die Schutzmittel der Blüthen gegen unberufene Gäste. 1876. *S. daphnoides,* Wachsüberzüge. (Just Bot. Jahresbericht 4: 942).—(9) Meehan, On self-fertilization and cross-fertilization of flowers. Penn Monthly. N 1876. *S. caprea.* Sep. pamphlet 1877. (Just 4: 939).—(10) H. H., Fertilization of Salix repens. Nature **16**: 184. 1877. Visitors. (Just 5: 746). —(11) Bonnier, Les Nectaires. Ann. d. Sci. Nat. Bot. 8: 39, 49–50, 57, 70–1. 1879. Several spp., visitors, etc.—(12) Müller, Weitere Beobachtungen. II. Verh. d. naturhist. Ver. d. preuss. Rheinl. u. Westf. **1879**: 210.—(13) Behrens, Biologische Fragmente Jahresbericht d. Naturw. Gesellschaft zu Elberfeld. 1880. *S. repens.*—(14) Delpino, Proporzione delle piante anemofile ed entomofile nelle isole. Revista Botanica **1880**: 50–2. Lit. (13) (Just 8^1: 190).—(15) Müller, Alpenblumen 162–3. 1881. —(16) Mez, Geschlechtsänderung einer Weide. Deutsch. bot. Monatschr. **1**: 93. 1883. *S. purpurea* × *viminalis.* (Just 11^1: 483)—(17) Müller, Fertilization of Flowers 524–6. 1883.—(18) Heinricher, Beiträge zur Pflanzenteratologie und Blütenmorphologie. Sitzber. d. K. Akad. d. Wissensch. Wien **87**: 1883. *S. caprea,* androgynous catkins. (Just 11^1: 483).—(19) Müller, Die Stellung der Honigbiene in den Blumenwelt III. Deut. Bienenzeit. **39**: 157–61. 1883. (Just 11^1: 476).—(20) Loew, Beobachtungen über den Blumenbesuch von Insekten an Freilandpflanzen des botanischen Gartens zu Berlin. Jahrb. bot. Gartens Berlin **3**: 82, 274, 276. (14, 72, 74). 1884.—(21) Warming, Om bygningen og den formodede bestövningsmaade at nogle grönlandske blom-

ster. Oversigt over d. K. D. Vidensk. Selsk. Forhandl. 1886: 116, 131, 156.—(22) Pax, Salicaceæ. Engler u. Prantl. Die nat. Pflanzenfamilien. 14: 33. 1887. (Just 16¹: 563).—(23) Bulman, The bee and the willow. Sci. Gossip 1889: 130.—(24) Kerner, Die Bedeutung der Dichogamie. Oest. bot. Zeitschrift 40: 2–3. 1890.—(25) Kerner, Pflanzenleben 2: 187, 311–12. 1891. Several spp. (Just 17¹: 532).—(26) Verhoeff, Blumen und Insekten der Insel Norderney. Nova Acta d. Kais. Leop. Carol. Deutsch. Akad. d. Naturf. 61: 63–8. 1893.—(27) MacLeod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek 6: 129–33, etc. 1894. — (28) Loew, Blütenbiologische Floristik des mittleren und nördlichen Europa sowie Grönlands. 1894. (11 spp).—(29) Knuth, Blumen und Insekten auf den Nordfriesischen Inseln 131–2. 1894. *S. repens.*—(30) Weed, Ten New England blossoms and their insect visitors. 1–17. 1895. *S. discolor*, visitors, etc.

IRIS Tourn.—In this genus we find regular trilateral nototribe flowers. Each sepal, with a stamen and a style-division, is modified into a form which is almost a functional equivalent of a specialized flower such as we find in the Scrophulariaceæ, etc. The form of the style serves to determine the kind of insect pollinators and secures the application of the pollen to the insect's back. Kerner (5, 23) mentions the style of *Iris* as serving to protect the pollen, without, however, showing the probability of this having anything to do with its development.

Except in the single case mentioned below, the flowers are adapted to bumblebees, but are also visited by other large bees, such as *Xylocopa* (Delpino 6), and in this country by *Synhalonia*. *I. pseudacorus* (Müller 4) presents an interesting case of what Errera and Gevaert (11) call *dientomophily* —having one form adapted to bumblebees and another adapted to *Rhingia rostrata*, a Syrphid fly. The only other case as yet recorded is that of *Aconitum lycoctonum*, observed by Aurivillius (see Ludwig 19, 25), which has one form visited by bumblebees and another visited by butterflies. Gibson (28) in an account of the blue-flag, accompanied by a figure evidently of *I. versicolor*, implies that *Iris* in general is adapted to bumblebees and large flies. "A large fly" is a rather loose synonym for *Rhingia rostrata*.

Iris has sometimes been used as a type of hercogamy (ercogame contingente, Delpino 6), but *I. sibirica* has been shown to be proterandrous (Dodel Port 24, Loew 30). It will be seen below that *I. versicolor* is also proterandrous to some extent. Meehan (9) records a case in which *I. virginica* is said to have proved fertile under a net.

IRIS VERSICOLOR L. Larger blue flag.—This flower is described by Professor Goodale in "Wild Flowers of America," 32–35, and is there illustrated by a drawing by Isaac Sprague.

Newly opened flowers show the anthers dehiscent, but the stigmatic lobe is so closely appressed to the summit of the style that the true stigma is not touched by a bee entering the flower. Then in the early stages the tip of the anther lies against the stigma lobe and prevents its being reflexed. Later the style lengthens and the lobe loosens so that the true stigma may be touched. From the above it will be seen that the flower shows a tendency to proterandry.

The flower is adapted to long-tongued bees I have seen it visited by *Bombus americanorum* F. ♀, *B. pennsylvanicus* DeG. ♀, and *Synhalonia frater* Cr. ♂♀, ab. I have also seen a beetle, *Trichius piger* F., enter the flower so as to effect pollination, but this insect cannot reach the nectar. Sometimes butterflies obtain the nectar in an illegitimate way by backing down to the base of the flower and inserting their proboscides between the bases of the "falls" and the style divisions. *Chrysophanus thoe* B.-L. and *Pamphila peckius* Kby. were observed stealing the nectar in this way.

The flowers bloom from May 20th to June 14th.

In New Hampshire, Weed (31) saw the flowers visited by bumble-bees, of which the most abundant species was *Bombus terricola*, and occasionally by some smaller bees. A more frequent visitor was "a good-sized syrphid fly—apparently a species of Rhingia." Several species of skippers (Hesperidæ) and Sphingidæ stole the nectar from the outside, as described above, *Hemaris thysbe* sometimes sucking in the legitmate way.

On the pollination of *Iris* see:

(1) Sprengel, Das entdeckte Geheimniss. 20, 43–4, 69–79. 1793. *I. pseudacorus, xiphium, germanica, sibirica.*—(2) Hildebrand, Geschlechtervertheilung bei den Pflanzen 59. 1867.—(3) Axell, On anordningarna för de fanerogama växternas befruktning 114. 1869. *I. pseudacorus*—(4) Müller, Befruchung der Blumen 67–70. 1873. Fertilization of Flowers 543–7. 1883. *I. pseudacorus.*—(5) Kerner, Schutzmittel des Pollens 12. 1873.—(6) Delpino, Ulteriori osservazioni Pt. II. fasc. 2. Atti d. Soc. Ital. d. Sci. Nat. in Milano. **16**: 196, 201, 217, 220, 235, 263, 282, 340. (48, 53, 69. 72, 87, 115, 134, 192) 1873. **17**:—(203–4, 247). 1874. *I. aphylla, viscaria, germanica, xiphium, halofila, graminea, florentina, pseudacorus.*—(7) Gray, Botany for young people. II. How plants behave 21, 25. 1875.—(8) Lubbock, British wild flowers in relation to insects 176. 1875. *I. pseudacorus.*—(9) Meehan, On self-fertilization and

cross-fertilization of flowers. Penn Monthly, N 1876. Sep. pamphlet (4). 1877.—(10) Delpino, Dicogamia ed omogamia nelle piante. Nuovo Giorn. Bot. Ital. **8**: 143. 1876.—(11) Errera et Gevaert, Sur la structure et les modes de fecondation des fleurs. Bull. Soc. bot. de Belgique **17**: 149. 1878. (Just Bot. Jahresbericht 6^1: 310)—(12) Hildebrand, Die Farben der Blüthen in ihre jetzigen Variation und früheren Entwickelung 36. 1879. (Just 7^1: 110)—(13) Dodel-Port, Die Liebe der Blumen. 4, 5: 185–240. 1880. (Just 8^1: 183)—(14) Gray, Structural Botany, 230. 1880. *I. pumila.*—(15) Focke, Nägeli's Einwände gegen die Blumentheorie, erläutert an den Nachtfalterblumen. Kosmos **14**: 295. 1884. Just 12^1: 668)—(16) Leow, Beobachtungen über den Blumenbesuch von Insekten an Freilandpflanzen. Jahrb. Bot. Gartens Berlin **3**: 84, 96 (16, 28) 1884. *I. xiphioides, germanica, sibirica.*—(17) Licopoli, Sull polline dell' Iris tuberosa ed altre piante. Rendic. Accad. Sci. Fis. e Mat. Napoli **24**:—1885. [No. 8.]—(18) Licopoli, Le pollen de l' Iris tuberosa. Journ. de micrographie **1886**: No. 2.—(19) Ludwig, Ein neuer Fall verschiedener Blütenformen bei Pflanzen der nämlichen Art, und ein neues Kriterium der Schmetterlings-und Hummelblumen. Biol. Centralblatt **6**: 24. 1887. (Just 15^1: 426)—(20) Licopoli, Sull polline dell' Iris tuberosa. Atti d. r. Acad. d. Sci. Fis. e Mat. II. **2**:—1888—(21) Pax, Iridaceæ, Engler und Prantl, Die nat. Pflanzenfamilien 10 u. 17: 140–1. 1888. (Just 16^1: 554)—(22) Loew, Beiträge zur blütenbiologischen Statistik. Verh. Bot. Ver. Prov. Brandenburg **31**: 43. 1890. *I. sibirica.*—(23) Kerner, Pflanzenleben **2**: 93, 111, 173, 197, 247. 1891. *I. germanica, odoratissima* etc. (Just 17^1: 528)—(24) Dodel-Port, Zur Kenntniss der Befruchtungserscheinungen bei Iris sibirica. Testsch. z. Feier d. 50 Jahr. Doctorjubiläums der Herren Nägeli u. Kölliker. 1891.—(25) Ludwig, Zur Biologie der. phanerogamischen Süsswasserflora (64) Zacharias, Das Thier- und Pflanzenleben des Süsswassers. 1891.—(26) Mac Leod, De Pyreneeënbloemen en hare bevruchting door insecten 306. 1891. *I. pyrenaica.*—(27) Mac Leod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek **5**: 168, 315. 1893. *I. pseudacorus.*—(28) Gibson, The welcomes of the flowers. Harper's Monthly **88**: 560. Mr 1894.—(29) Dodel-Port, Biologischer Atlas der Botanik. Serie "Iris." 1894. *I. sibirica*, plates and text. (Knuth Bot. Centralblatt **58**: 95)—(30) Loew, Blütenbiologische Floristik 64–5, 346 391. *I. xiphioides, pseudacorus, sibirica.* 1894.—(31) Weed, Ten New England blossoms and their insect visitors 98–104. 1895.

Carlinville, Illinois.

The nomenclature question.

Some inconsistencies in plant nomenclature.

In a recent unpublished letter a prominent botanist calls attention once more to an argument that has often been made use of by the opponents of the so-called "reform" movement in botanical nomenclature: namely, that a motive, if not indeed the prime motive, for all this upsetting of names is to be found in the desire of the reviser to append his own name to all possible combinations of genera and species; in other words, that the sole end and aim of this nomenclatorial agitation is the theoretical opportunities it gives for incompetent writers to juggle with the names of our plants with the purpose of constituting themselves the authority for as many as possible. As a matter of fact nothing could have been farther from the minds of the nomenclature committee than this feature; and it was largely to obviate just such a possibility that the reform movement originated. By setting an initial date logically fixed at the beginning of binomial nomenclature behind which it is agreed not to go, and referring each species to the oldest subsequent name, the matter becomes fixed for all time. It is unfortunate that it is found necessary to change so many of our plant appellations, but when once so changed in accord with this logical principle, we shall have, it seems to me, a practically stable system of nomenclature. Other departments of biology have long since found it necessary to adopt similar rules, and their experience proves conclusively that it is a reform which reforms. The American ornithologists, for example, have been obliged to make less than one per cent. of corrections during the ten years' application of their code, and not one of these corrections was due to mere personal opinion; the nomenclature of North American birds is therefore practically stable, and I can see no reason why the botanists may not consequently hope for a similar fixation of plant names.

In order to show that the principle is open to criticism which regards the last author of a combination of genus and species as more important than the original namer of the same plant, I take the liberty of citing a number of examples. In the Synoptical Flora of North America **1**[2]: 397–407, the genus

Cnicus is found to embrace forty-two species and varieties. Of these, Gray is given as authority for no less than thirty-two; but by looking through the synonymy it appears that fifteen of the names, or nearly fifty per cent., had been given previously by other authors, as Nuttall, Muhlenberg, Hooker, Engelmann and De Candolle. Thus *Carduus undulatus* Nutt., 1818, becomes *Cnicus undulatus* Gray, 1874; *Cnicus discolor* Muhl., 1804, becomes *C. altissimus* var. *discolor* Gray, 1883, etc. The same practice may be observed in Watson's treatment of Lesquerella elsewhere, in which twenty-four out of thirty-five names credited to him had been previously given by other authors. All right and title of the original discoverer of a species thus disappears.

Another step in the working of this principle is shown in the recently issued fascicle 1 of volume **1**, part 1 of the Synoptical Flora, where the transferred species or varieties are followed by the abbreviations "n. sp." or "n. var." as the case may be. Thus we learn that *Clematis Pitcheri* var. *Bigelovii* is a "n. var." notwithstanding the fact that *C. Bigelovii* was described by Torrey in 1856! *C. Pitcheri* var. *filifera*, another "n. var." was described as *C. filifera* by Bentham in 1848. *C. verticillaris* var. *Columbiana* Gray, n. var. 1895, was described originally by Nuttall in 1834 and was made a "new species" again by Torrey and Gray in 1838. *Eutrema Eschscholtzianum* Robinson, n. sp. 1895, is *Aphragmus Eschscholtzianus* Andrz., 1824, while *Braya humilis* Robinson, n. sp. 1895, is *Sisymbrium humile* C. A. Meyer, 1831. It is unnecessary to multiply examples. To my mind it does not seem probable that the practice of placing one's name after a species is likely to be more abused by the advocates of sound nomenclature than it has been in the past by the adherents of conservatism. It has usually been the custon to append "n. sp." or "n. var." only to species or varieties that are described for the first time as new to science, although the same abbreviations have occasionally been used where it has been found necessary to give a new name to a previously described plant, instances of which may be found in this same fascicle of the Synoptical Flora. This is the usage throughout the whole range of biology, without, so far as I can find an exception. If this innovation should ever become general, some other method of designating species and varieties that are really

new will have to be devised, since the old familiar practice will have lost its force.[1]

The facts in the case, it seems, are simply these: The proposition that the author who makes "the first correct combination" of genus and species is entitled to more credit than the original discoverer of that species, cannot be maintained. Upon this point the committee appointed by the British Association to prepare a code of nomenclature makes the following statement:

". . . We conceive that the author who first describes and names a species which forms the groundwork of later generalizations possesses a higher claim to have his name recorded than he who afterward defines the genus which is found to embrace that species, or who may be the mere accidental means of bringing the generic and specific names into contact. By giving the authority for the specific name in preference to all others, the inquirer is referred directly to the original description, habitat, etc., of the species, and is at the same time reminded of the date of its discovery."

This committee numbered Darwin, Henslow, Wallace, Babington, J. D. Hooker, Balfour and Bentham among its members.

To the statement that preference should be given to the referrer of the species to its proper genus on the ground that "it requires greater knowledge of the structure and relationship of species to properly classify them than to simply name and describe them," the code of nomenclature adopted by the American Ornithologists' Union says, "But it often happens that the authority for the combination of names used is not that of the classifier, but of the author who merely 'shuffled names,' or worked out the synonymy in accordance with nomenclatural rules, and has had nothing to do with the correct allocation of the species."

The concurrence of opinion is, therefore, to the effect that the name of the original author of a species is an inseparable part of the specific name, and should go with it no matter what its vicissitudes may be, not only as a matter of simple justice, but from the standpoint of historical accuracy. This so-called "correct combination" is a personal equation and

[1] Since the above was written Prof. Bailey has, unfortunately it seems to me, adopted this innovation and writes "*n. sp.*" after his *Carex Arkansana*, which had been described as *bona fide* new as a variety in 1888.

can never be a fixed quantity. It needs but a glance at our manuals to show that generic and specific limitations are variously understood by writers, and who shall be entitled to say which is the truly "correct" combination? Indeed the authority for the last combination is regarded as of so little importance by American ornithologists that they omit it in writing the names of North American birds. Personally, I prefer the double citation, for then the history of the species becomes complete. The namer of the species and the authority for its present combination both receive the recognition justly due them.—F. H. KNOWLTON.

Botanical nomenclature.

Perhaps enough has been said on the subject of botanical nomenclature, yet I would like to offer some comments on certain phases of it that have been made prominent by some of the advocates of the Rochester and Madison rules.

It seems to be taken for granted by them that the signers of the Harvard circular were, and are, influenced by considerations of sentiment and prejudice in opposing the so-called reform in botanical nomenclature, whereas the contrary is the truth.

To assert that such men as Dr. Farlow, Prof. Eaton, Dr. Goodale and Dr. Robinson, and I might very properly add Dr. Gray and Sereno Watson who when living were in sympathy with the spirit which subsequently found expression in the Harvard Circular, would permit themselves to be influenced by mere prejudice and sentiment in such a matter is quite as discreditable to those eminent botanists as it is to those who make the assertion. Rather it is that the signers of that Circular believe with the late Prof. Eaton, who wrote me to this effect only a short time before his fatal illness, that the proposed methods of reform, so-called, would tend to increase rather than to diminish confusion.

By far the ablest paper, the fairest and most courteous that has yet appeared in defense of the new rules is that published by Lester F. Ward in the *Bulletin* of the Torrey Botanical Club in July, 1895, yet Mr. Ward certainly errs in assuming that the signers of the Harvard Circular are influenced by mere sentiment and prejudice, or a "personal disinclination to incur the annoyance of accustoming themselves to a new set of names." Among those signers of whom I have knowl-

edge and acquaintance the contrary is true. But one may well pause to consider the deplorable results likely to accrue from the ambitious revisions of the time-honored work of our greatest botanists through the opportunities opened up by the new system before approving of a method which tends to increase confusion by the multiplication of needless synonyms.

If Mr. Ward's suggestion of doing away altogether with authoritative names could be carried out it might perhaps do away with much of this objection by removing at least one motive for it, but it is doubtful if the suggestion is practicable, or desirable if practicable. An author's name has a certain historic significance and value. It not only furnishes a means for reference, but it is an indication of the direction in which one is to look for a knowledge of the plant's history. To advocate its removal on the grounds of "style" as Mr. Ward does, is to appeal directly to the purest sentiment; for what is style but sentiment, and what has science to do with sentiment? Here, it seems to me Mr. Ward is somewhat inconsistent. He accuses the signers of the Harvard Circular with being influenced by sentiment and prejudice, which we deny, and then suggests a change which has for its very foundation the purest sentiment possible whose legitimate field is the realm of literature only.

Again Mr. Ward errs when he says that "principle is cast aside for sentiment, and because Swartz' name of Aspidium happens to be in common use among fern gatherers (why not botanists?) we are enjoined from taking up the perfectly valid designation Dryopteris given years previously by Adanson." On the contrary the argument here is all against him, and, on their own grounds, of those who attempt to substitute Dryopteris for Aspidium. There is no sentiment at all about it. It is a practical application of the principles of priority as I understand them, as they were held by Prof. Eaton, and all botanists who adhere to Swartz' genera.

When Swartz elaborated the genus Aspidium he originated an entirely new order of things back of which there is absolutely nothing entitled to consideration. "Swartz was the first to reduce fern genera to anything like systematic order," wrote Prof. Eaton to me not long ago, and his work has received the endorsement of nearly a century; of what value as against it, is the obscure, insufficient and unscientific reference merely of Adanson, who himself borrowed the name Dryopteris from Dioscorides of the first century?

I have alluded to Mr. Ward's paper because it represents the best of what I am criticising. It is in fact the strongest and best defense of the Rochester and Madison rules that I have seen, and I doubt if an abler can be made; but I feel obliged to dissent from its conclusions though gladly bearing witness to the admirable spirit of courtesy with which it is so thoroughly imbued.

The argument however which he draws from analysis between searching for the parentage of a lost child and a lost plant, though ingenious and taking, is like a two edged sword that cuts both ways, or a boomerang that rebounds upon its thrower, and any such analysis is false and misleading with little or no application to botanical science. If this is not so, one might offer a similar analysis with an entirely different result. For example: the new nomenclature insists upon the specific name being in itself the name of the plant although such is not the fact. John Smith has two sons, William and John, either one of whom under certain conditions, and at certain times may properly be called Mr. Smith, or, in the privacy of their own homes, William, or John; but when it comes to public recognition it becomes necessary to designate either, or both, as the case may be as William Smith, John Smith, Jr., the abbreviation being affixed to distinguish the younger from the elder John, or it may even be necessary to add the residence, even to the detail of street and number in order to distinguish the sons of John from the sons of Samuel before the absolute identity of either of the Smiths can be conclusively established; so that a knowledge of the full name is necessary to fix the personality of each individual for a certainty.

Now among the ferns there are many distinct species bearing precisely the same specific name, so that if the specific name alone is the true name it would obviously be impossible to distinguish the different individuals by their names alone. The mere statement of this is sufficient to show the necessity for some other distinguishing appellation and the superiority of the generic name. The fern is an Acrostichum, an Asplenium, a Myriophyllum or a Botrychium with or without its specific name, but not a lanceolatum, a Wrightii or a Lindeni isolated from the generic. The two names are inseparable. Otherwise there could be no good reason for fixing upon the beginning of the Linnaean binomial system for plant nomen-

clature, and we might as well go back to the very beginning of plant names if we want to be absolutely just and "render unto Cæsar the things that are Cæsar's." On this point no less an authority than Bentham declared that "the specific adjective of itself is not the name of a plant," and that "for a species the combination of the substantive and adjective is absolutely necessary." It follows from this that a plant is not correctly named, until it receives its proper generic and specific name in combination.

But perhaps the strongest objection to the insistence on the use of the specific name under any and all circumstances is the absurdity to which it leads in the use of homonyms. In a reply which I wrote to Mr. Stearns' paper on Nomenclature in the *Bulletin* of the Torrey Botanical Club, but which was withheld from publication, I pointed out that the legitimate outcome from the proposed reform, if carried out, must lead to the adoption of what DeCandolle, Bentham, Dr. Hooker, Dr. Gray and such eminent botanists had always regarded as too absurd for consideration, as it was not thought probable that any botanist would adopt anything of the kind. Yet it has come about exactly as I said and we are treated to such absurd combinations as Phegopteris Phegopteris, Scolopendrium Scolopendrium, and such startling propositions as Polypodium polypodioides—a Polypodium that looks like a polypodium! What a wonderful revelation of scientific knowledge and information that is, to be sure, and how helpful it must be to the average collector in the field!

I have elsewhere stated my willingness to sacrifice my own personal views and accept without reservation any code approved by representative botanists of all countries in an international congress. National pride, the heritage from generations of American born ancestors, would naturally incline me to prefer methods originating in American atmosphere, but science is cosmopolitan and knows no boundaries. She seeks only for the truth, and the best, come from where it may, and therefore it has seemed to me that the so-called Vienna rules proposed by the German botanists at Berlin offer a much better basis for permanent agreement than our own and I would be glad to see them, or similar ones prevail.—GEORGE E. DAVENPORT.

Some remarks on nomenclature.

I cannot see how the nomenclature question can otherwise be settled than by a Paris congress in the year 1900 with four

or five years international preparation for the reformed Paris Codex.

But the Société botanique de France needs to be encouraged by foreign botanists to arrange for such a congress, inasmuch as the nomenclature questions are the least treated by French botanists, and the Paris Codex of 1867 was more the work of foreigners.

It seems also that the French Botanical Society lacks the funds to prepare properly for such a congress; in your country more is spent for science by private people than in any other land, so it is to be hoped that somebody will offer money promptly for that purpose, helping thereby to establish an international nomenclature of plants.

I did not mix after 1893 in the United States botanists' quarrels over nomenclature, considering them as home quarrels. But I may say that wrong enough has been done on both sides, and I proved only in 1894 that the two specific North American rules, accepted so promptly in Madison before the beginning of the congress there, were very bad. See my *Nomenclaturstudien* in Bull. Herb. Boissier. The BOTANICAL GAZETTE, although most conciliatory and impartial, did not print my figures, which convinced the European botanists about the harmfulness—if retroactive—of the two American rules, so I hope you will do it still. 1. "*Priority in place at all events*" from Linné's *Species Plantarum* 1753 causes the changing of at least twenty generic names and 4,600 specific names. 2. The rule: "*Once a synonym always a synonym*" is very bad if retroactive. I gave in my *Nomenclaturstudien* a list, made in a short time, of 200 generic names of personal derivation, which would thereby be changed with about 1,737 specific names. Surely for the whole system 300–400 more generic names would lose their *usual* names. For the future that rule is excellent; that is to say not for the "future difficult to define" but for each future case. If any one finds a name whose renewal is necessitated by priority, he shall not renew it, if a former homonym exists since the international beginning of our nomenclature. That is very easy to manage.

It is quite untrue as stated in another United States paper, that the so-called Vienna rules of 1894 were accepted in Vienna by the German and Austrian botanists. On the contrary they were rejected and left to a future congress, for

which congress at Berlin, although proposed for 1895, nothing has been done or prepared, so far as I know, although I worked in the Berlin botanic museum till last October.—OTTO KUNTZE, *San Remo, Italy.*

Dates and references, and priority in nomenclature.

It does not seem too much to expect from those who would purify botanical nomenclature, that they should be themselves pure. But those who have had to do with comparing references with the originals, will be surprised at the enormous number of inaccuracies that pass current. A new reference book is required as badly as a purified nomenclature. In the preparation of the chapters to go with the plates in my "Flowers and Ferns of the United States," and its continuation, "Meehans' Monthly," I have tried to verify original references, and can say of my own personal knowledge that references to dates and authors are in a most deplorable condition.

I am just now at work on the two species of *Chimaphila*, *C. umbellata* and *C. maculata*. My good friend Conway MacMillan contends in the "Metaspermæ of the Minnesota Valley" that we must drop *Chimaphila* of Pursh (1814), and adopt *Pseva* of Rafinesque," Jour. Phys. **79:** 261. 1809. I turn to "Index Kewensis," and find it is "Jour. Phys. Sc." thus indicating that it may be an English title, but there is no such work. I try again and examine the work usually referred to as "Jour. Phys.," Desvaux "Journal de physique," and examine page 261, volume 79, but there is not a word about Rafinesque or botany. Looking again at "Index Kewensis," I suspect an error in adding "Science" to the title, and note that they give 1819 for the date, instead of 1809. Examining "Journal de Physique" for that year, I find a paper by Rafinesque entitled "Remarks critiques et synonymiques sur les ouvrages de MM. Pursh, Nutt.,"—and a host of others —"sur les plantes des Etats-Unis." These authors are handled without gloves, and one can hardly wonder at the coolness shown to him by his co-laborers. "*Ipomopsis* Mx., and *Ipomeria* Nuttall, are absurd." "*Ammyrsine* Pursh is an abominable name." *Mahonia* should be changed "as dedicated to a gardener who does not merit the honor." "*Lyonia* should be changed as it is too near *Allionia*." "*Epifagus* Nuttall, is an absurd name." The whole paper is simply a critique, with no pretension of describing anything. But

there is a reference to "*Pseva.*" "*Chimaphila* Pursh is *Pseva* Raf. Obs., but the name of Pursh is better and more significant." This is all, and this is the authority of "Index Kewensis" for the name.

A clue is at length furnished by Rafinesque's own work "Medical Botany," under *Pyrola maculata.* "The genus must be divided into sub-genera: *Streptylia, Orthylia, Psiseva* and *Chimaphila.*" Under *Psiseva* he would only retain *P. maculata,* even as a subgenus. For this name he quotes Raf. 1808. Prof. MacMillan has *Pseva* 1809. I can find nothing in 1808 relating to it. But there is another reference, "Observations on some plants of the United States in Medical Repository for 1809." I cannot find this. If it be here that the name was first employed, we have Rafinesque misquoting his own date!

Just here comes in another matter: how far may we be justified in changing an evident error in orthography in an author's name? Those who are acquainted with Rafinesque's handwriting as I am, know how difficult it is to determine the individual letters, and how fond he is of abbreviations. It is no wonder the printer set up *Scoria* for *Hicoria.* In the article cited from Desvaux "Journal de Physique," Dr. Torrey is criticised through the chapter as Dr. Jorrey. He seems, however, generally, to accept these printed versions of his manuscripts. *Pachistima,* if it had been employed by Nuttall or Pursh, he would have characterized as "absurd" or "abominable," and suggested something else. Meisner corrected it subsequently to what Rafinesque's manuscript no doubt intended, *Pachystigma,* but no one follows it.

By the form *Psiseva,* which he uses in "Medical Botany," I have little doubt he intended to name this plant after its Indian name Pipsisewa, but that the printer in despair at the manuscript, rendered it Pseva, an "absurd and meaningless" name; or, likely as not, he may have writted P'seva.

But—and this is what I want to emphasize—ought not reformers to reform along the whole line, and not puzzle us in this way?—THOMAS MEEHAN.

BRIEFER ARTICLES.

LASIODIPLODIA E. & E., n. gen.—*With Plate V.*— Perithecia collected in a stroma, clothed with brown mycelium; basidia and sporules with paraphyses intermingled; otherwise as in *Diplodia.*

Lasiodiplodia tubericola E. & E., n. sp.—Perithecia globose 250–350μ (inner cavity 175–190μ), clothed outside with an abundant brown septate sparingly branched mycelium, stromatically connected in a small hemispherical erumpent tubercle about 1^{mm} diam. Sporules elliptical, short stipitate, hyaline and continuous at first, becoming brown and uniseptate; 18–22×11–14μ; not constricted; overtopped by filiform processes 45–55μ long, resembling paraphyses and springing with the basidia from the proligerous layer.

The above fungus was found on some sweet potatoes that were brought to the Louisiana Experiment Station from Java, in the spring of 1894. The potatoes appeared sound, and were planted a day or two after they were received. Failing to grow, they were dug up some ten days later, and were found to be rotting. The fungus causing the rot was sent to Mr. Ellis to be identified, and he pronounced it a new genus, giving it the name *Lasiodiplodia tubericola.*

Externally, sweet patatoes attacked by this fungus, show dark shriveled patches, over which are scattered little black pustules. The tissue within is slightly spongy, rather moist, and in color is a mixed olive-green and grey. The olive-green parts show an abundant, dark-brown, septate, branching mycelium running between and through the cells of the host (fig. 1). It may be added also, that the mature brown spores frequently show longitudinal striations (fig. 4).

As *Lasiodiplodia* has not been previously described, and the diseases of the sweet potato have been pretty thoroughly studied in the United States, it seems more than probable that the form is an imported one. Sweet potatoes brought from Java in February, 1895, were found affected by the same fungus when they were received at Baton Rouge, so in this case they could not have been infected from the soil at the Louisiana station.

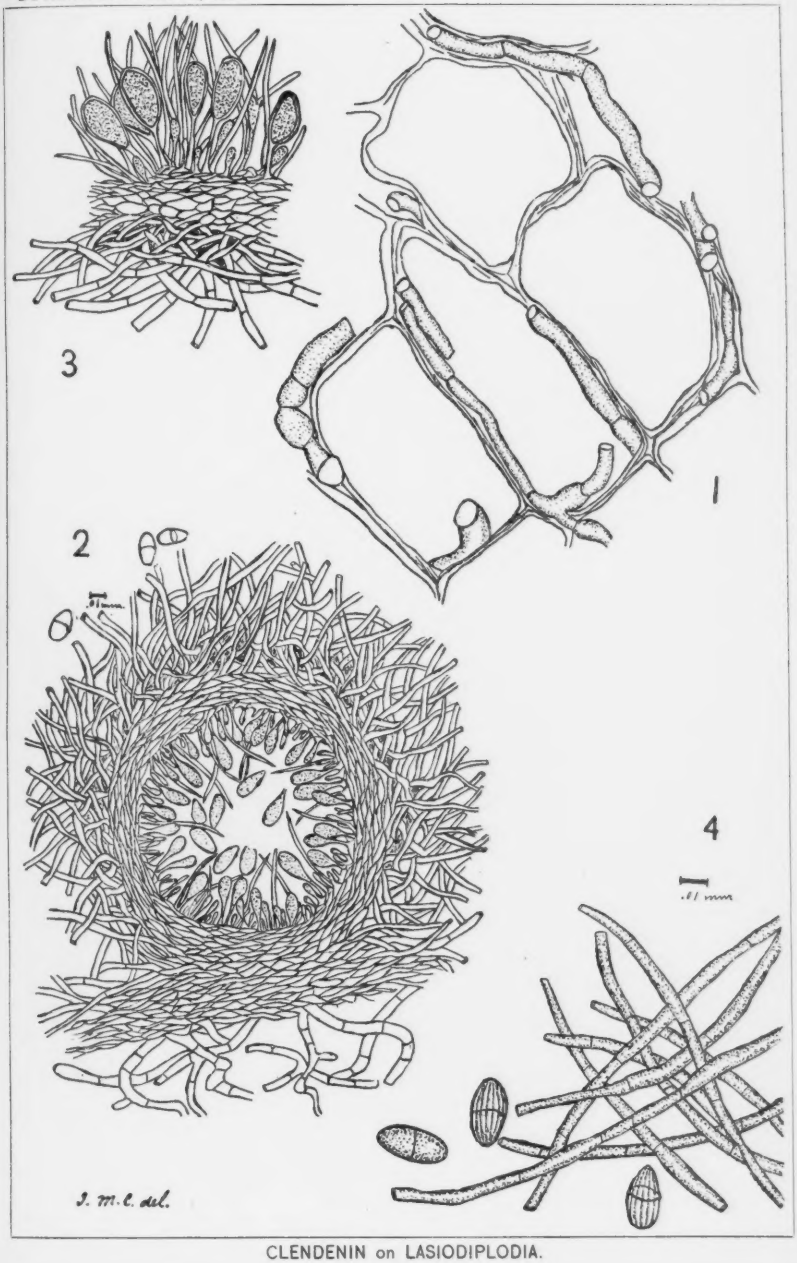
Cultures of the fungus have been undertaken, looking to the working-out of its life history.—IDA CLENDENIN, *The Girls' High School, Brooklyn, N. Y.*

EXPLANATION OF PLATE V.—Fig. 1.—Mycelium of *Lasiodiplodia tubericola* passing through and between the cells of the host.

Fig. 2. Perithecium of same. Paraphyses and immature spores within. Three mature spores without.

Fig. 3. Portion of perithecium more highly magnified.

Fig. 4. Mature spores and external brown mycelium.



CLENDENIN on LASIODIPLODIA.

CURRENT LITERATURE.

Mosses and ferns.

Dr. Campbell's long continued studies upon the ferns and liverworts have prepared him admirably for the preparation of the volume on the Archegoniatæ which has recently been issued.[1] This is beyond question the most important morphological work yet published by an American botanist and the publishers have given it a dress worthy of it.

In this work Professor Campbell brings together a large amount of heretofore scattered information regarding these plants, not a little of which he has himself contributed. The first 150 pages are devoted to the Hepaticæ, less than 70 to the Musci, and 300 to the Pteridophyta. In this distribution of space the author has done wisely, giving to the polytypic liverworts a fuller discussion than the much less varied mosses, a course more necessary as the liverworts are considered by Dr. Campbell in all probability the progenitors of both mosses and ferns. While this proportion is a perfectly just one, it is also one which accords with the author's predilections and the length corresponds curiously with the strength of treatment.

It is impossible to criticise this excellent work in detail. It must suffice to say that the full and lucid account of the structure and development of archegoniate plants will be most helpful, not only to students of these groups, but also to those teachers who, because their special studies lie in other lines, need such a compendium as this to which they may turn with confidence. For the book is compendious rather than philosophical. The author seems to have avoided of set purpose any extended theoretical discussions. He has, however, given us admirable condensed statements of the affinities of the most important groups outlining divergent views when they exist. (It may be here noted in passing that by an error, apparently typographical, on p. 513, Bower's theory is misstated.)

One of the most important features of the book is that the author has been able by reason of his study of a considerable number of American species to use these in illustration of morphological points. The use of Funaria hygrometrica to illustrate the structure of the stegocarpous mosses is therefore something of a disappointment, for

[1] Campbell, D. H.—The structure and development of the mosses and ferns (Archegoniatæ). 8vo. pp. viii + 544. figs. 266. New York and London: Macmillan & Co. 1895.

this moss has been exploited until the very name is a weariness to the flesh.

Dr. Campbell has laid us under obligations further in publishing a large number of new drawings, whose freshness commends them as well as their natural look. Many of these leave nothing to be desired, especially the outline drawings, but some are really too sketchy and crude to be found in such good company. The re-drawing of illustrations from other papers is not usually well done. One would rather see Luerssen's beautiful figures of Salvinia, for instance, than these pen sketches of them.

We have more serious fault to find with the book on the score of terminology than any other. The homologies among the archegoniates are so plain and well-known that it seems a pity to continue to encumber terminology with words whose existence only emphasizes dissimilarity. Dr. Campbell adopts gametophyte and sporophyte, it is true, to designate the sexual and non-sexual stages, but he continues to use sporogonium and prothallium in a way that would be confusing to a novice. For example: "The most striking difference, then, between the sporogonium of Anthoceros and the sporophyte of the simple pteridophytes," etc., p. 513. The subheads are not only everywhere particularly illogical but also lend their aid to create confusion of ideas. For example, under the Marattiaceæ, there is a subhead, *the gametophyte*, under which the sporophyte is also described; under Isoetaceæ the subheads are the gametophyte, the embryo, the sporophyte, the sporangium.

This failure to discard obsolescent terms leads naturally to the occasional inculcation of some antiquated ideas. E. g., p. 5, "In the bryophytes, as a class, the gametophyte is more important than the sporophyte, the latter being, physiologically, merely a spore-fruit . ." This is very questionable from the physiologists' standpoint and the less said about such analogies in morphological treatises the better.

If we may now express regret that the author did not provide a good index—something more than a mere register of names—our unwelcome task of pointing out the few blemishes in a most praiseworthy book shall be concluded.

The soil.

Since land plants are so largely influenced in form and function by the soil a book upon the physics of the soil has great interest for botanists, and all the more when the subject is treated from the point of view of the agriculturist. Professor King's researches at the Univer-

sity of Wisconsin upon the soil water have led him to a general study of soil physics and at Professor Bailey's suggestion he has prepared this book as the first volume of a "Rural Science Series" (L. H. Bailey, editor, issued by Macmillan & Co.) which is to be an authoritative series of readable monographs treating rural problems in the light of underlying principles. It is particularly appropriate that the initial volume of the series[1] should discuss the soil, upon which most "rural problems" depend.

The book treats concisely and interestingly the nature, functions, origin, texture, composition, and kinds of soil; nitrogen of the soil; the distribution of roots; relation of air and water to soil; temperature; drainage and irrigation; and the physical effects of tillage and fertilizers. In most of these chapters there is much to interest the physiologist and the book may be commended as a necessity for the library.

Minor Notices.

JUST'S BOTANISCHER JAHRESBERICHT is so well known that it seems scarcely necessary to call attention to its value. The twentieth volume has recently been completed.[2] This Annual Report endeavors to give reviews every year of all botanical works, treating bacteriology and pharmacy only so far as these are of general interest to botanists. In producing this invaluable work of reference Dr. E. Koehne, the editor, is aided by several well known specialists. By giving abstracts hereafter in a more concise form, the Annual Report is to be reduced both in price and size. The completeness of this work is a consideration of so much importance for all botanists that the editor earnestly requests botanists in all countries to send him separates of all papers, especially of such as are not likely otherwise to be referred to in the Annual Report. Such contributions would permit more prompt publication and justify more reliance upon the Report. It is particularly requested to send everything to the editor's adddress: Professor Dr. E. Koehne, Friedenau-Berlin, Kirchstr. 5, Germany.

AN ANNOTATED LIST of the aquatic phanerogams of Iowa has been distributed by Mr. R. I. Cratty[3] as a separate from the science bulletin of the State University of Iowa. It embraces eighteen genera and

[1] King, F. H.—The soil; its nature, relations, and fundamental principles of management. 12mo. pp. xvi + 303. figs. 45. New York: Macmillan & Co. 1895. $0.75.

[2] Koehne, E.:—Just's botanischer Jahresbericht, systematisch geordnetes Repertorium der botanischen Literatur aller Länder. Berlin W., am Karlsbad 15. Gebrüder Borntraeger. Jährlich 40 m.

[3] Cratty, R. I.—Notes on the aquatic phenogams of Iowa. Extracted from Bulletin Lab. Nat. Sci. State Univ. Iowa **3**: 136-152. Dec. 16, 1895.

forty-one species. Nine species are added to the state flora as heretofore listed in Arthur's "Contributions to the flora of Iowa" and Hitchcock's "Catalogue of the Anthophyta and Pteridophyta of Ames." They are the following: *Echinodorus rostratus* Engelm., *Lophotocarpus calycinus* (Engelm.) J. G. Smith, *Potamogeton heterophyllus* Schreb., *P. major* Morong, *P. Nuttallii* C. & S., *P. pusillus* L., *P. spirillus* Tuck., *Sagittaria Arifolia* Nutt., and *Wolffia brasiliensis* Wedd. It is a most excellent piece of local botanical work. The data are very full and so critically considered that they can be taken as authoritative. Local lists of this kind are most welcome, and their number should increase.

A CHARMING little book is that Professor W. W. Bailey has written about Rhode Island wild flowers.[1] It has the breath of the woods about it, especially as we follow the author to the "favored spots" where grow the floral prizes. Like the trumpet to the war horse, the book stirs us and arouses the desire to wander afield again and gather the treasures which used to awaken our earlier enthusiasm. With the entertaining chapters go some of scientific value which record Rhode Island ferns and trees; but the book is primarily for the nature lover.

A MOST COMMENDABLE and serviceable work has just been published on the bibliography of Italian botany by Prof. P. A. Saccardo.[2]

Brief biographical items and the titles of chief works of 1434 Italian and 287 foreign writers on the botany of the country are given. Whatever has been anticipated in Pritzel's *Thesaurus* is referred to and not duplicated. The work also includes notes on all public, private and educational botanic gardens, of which the number is surprisingly large, including a list of their publications. Some other matters also find place.

[1] Bailey, W. W.—Among Rhode Island wild flowers. 12mo. pp. xii + 105. pl. 3. Providence: Preston & Rounds. 1895.

[2] Saccardo. P. A.—La botanica in Italia; materiali per la storia di questa scienza. 4to. pp. 236. Venezia, 1895. 10 fr.

NOTES AND NEWS.

THE PIGMENT of the negro skin, also found in white races to a much less extent, is believed (Abel and Davis in *Science* **2**: 110) to hold some chemical relation to chlorophyll.

A KEY TO THE WOODY PLANTS of Mower county, Minnesota, has been published by Mr. K. C. Davis. It is intended to be used in the winter time, and embraces fifty-two species of ligneous plants.

THE BOTANICAL LIBRARY of Mr. C. G. Lloyd of Cincinnati numbers 3,000 bound volumes and 1,000 pamphlets, and contains many choice and valuable works. It receives a large number of additions yearly.

TOXICODENDRIC ACID, which was studied by Maisch in 1865, and since that time generally accepted as the poisonous principle of Rhus Toxicodendron or poison ivy, is now said by Pfaff (*Science* **2**: 118) to be identical with acetic acid, and that the poisonous substance is an oil, which he calls toxicodendrol.

MR. EDWARD C. JEFFREY, of the University of Toronto, finds that Erythronium Americanum shows polyembryony which is exactly homologous with that common among gymnosperms. The fertilized egg produces a mass of cells which produces on its free surface two, three, or even four embryos. Of these only one persists in the ripened seed. Cf. *Annals of Botany* **9**: 537. D 1895.

A CORRECTION.—In the GAZETTE for May, 1894, under the title of "Notes from Vermont," I stated that *Aster tardiflorus* L. had been collected in Smuggler's Notch. This was determined for me by competent persons, but the determination was incorrect. The plant in question is a form of *A. Novi-Belgii* L. The *Myriophyllum scabratum* Mx. proved to be *M. Farwellii* Morong.—A. J. GROUT, *Columbia College, N. Y.*

COLLECTIONS FROM the western coast of Greenland are reported upon in the *Proceedings of the Philadelphia Academy of Sciences* by Mr. Wm. E. Meehan (April, 1892) and again by Mr. Theo. Holm (Feb. 1895). As this insular region possesses much interest to the geographical botanist it is worthy of note that the plants on which these reports are based are deposited in the Academy of Sciences in Philadelphia and a partial duplicate set in the national herbarium at Washington, and that the second paper supplements the first by correcting a number of determinations.

AN ADDITIONAL donation of $10,000 for the endowment of the New York Botanic Garden has recently been received from Mrs. Esther Hermann. This garden, if it continues to receive the attention from wealthy residents of New York that it has so far received, is likely to be within a few years the foremost botanic garden in America, and one of the largest in the world. The work of constructing roads and erecting buildings will begin in the spring. About 250 species of

plants in addition to those now growing on the grounds have been placed in a temporary nursery, and a gift of $5,000 worth of plants from Mr. James A. Pitcher is available at any time.

RAMIE, THE FIBER derived from Boehmeria, is the material of the ancients, which has been called linen and cotton by translators, according to Mr. C. O. Boring, who writes in the *Dry Goods Bulletin* (**18**: 12) for Jan. 1, 1896. The fiber is an extraordinarily pure cellulose exceeding cotton, and by improved methods of preparation becomes a rival to silk in luster and susceptibility to color. The fiber is long and very strong, and is capable of being woven into cloth of almost any texture. The native B. cylindrica has a good quality of fiber, but the species usually cultivated is B. nivea. The latter is grown in Louisiana, Texas and California, and as a manufactured article reaches this country from China under the name of China grass cloth.

THE PHARMACEUTISCHE RUNDSCHAU has changed its name to the *Pharmaceutical Review*, and is hereafter to be published chiefly in English, though not to the exclusion of German articles. The veteran editor, Dr. Fr. Hoffmann, retains his connection with the *Review*, but has associated with himself as the active editor Dr. Edward Kremers, Director of the School of Pharmacy of the University of Wisconsin. The direct cooperation of seven of the leading pharmacists and chemists has been secured and their names appear upon the title page. The place of publication also changes from New York to Milwaukee, where the Pharm. Review Publishing Co. has charge of all business matters. The *Review* has not only maintained a high scientific standard but has in the past kept itself absolutely free from commercial influence, a policy which will no doubt be consistently adhered to in the future. Botanists will find much in the pages of the review of most direct interest and we cordially commend it to our readers.

TRABUT[1] describes two modes in which *Aristida ciliaris* Desf. is protected against creeping insects. The plant inhabits the desert of Sahara and shows there the development of a ring of long, divaricate hairs at the nodes, which prevents creeping insects, ants, etc., from reaching the inflorescence. The same species has lately also been found by Ain Sepra in South Oran, but represents here a singular variety, being destitute of the hairy ring, but showing a secretion of a viscid substance, which covers a part of the internodes near the node. The other part of the internode is very smooth as in the typical plant. It is curious if this plant should, really, have been able to protect itself against the ants, while other species as *A. pungens* from Sahara and *A. oligantha* from North America are said to be eagerly sought by the ants, which should gather their grains. The author says that *A. oligantha* is called "blé de fourmis" in Texas, a fact that is not recorded in our agrostological works.—T. H.

PARASITIC FUNGI, as an index to the inner nature of plant hybrids, have been tested by Dr. Jakob Eriksson at the experiment station in Stockholm, Sweden, in a particularly interesting manner (*Botaniska*

[1] L. Trabut: *Aristida ciliaris* Desf. et les fourmis. Bull. de la soc. bot. de France **41**: 272. 1894.

Notiser **1895**: 251–253). Plants grown from seed received from Germany were attacked by rust, which proved to be *Puccinia dispersa* Eriks. & Henn., a species having two well marked physiological races, one maintaining itself on rye and the other on wheat. The plants on which it was now growing were supposed hybrids between rye and wheat, the crosses having been made by Dr. Rimpau of Schlaustedt, the previous season, and while looking in general much like wheat, had the elongated heads of rye. The uredospores from the rust on these supposed hybrids were sown on young rye plants (25 infections) and on similar wheat plants (26 infections). In fifteen days all the infected spots on the wheat plants showed characteristic pustules, while the rye plants remained entirely free, although the observations were continued for thirty-five days. The conclusion is inevitable that the presence of this particular race of rust showed that the supposed hybrid partook of the physiological nature of wheat and not of rye, whatever might be true of the morphological characters.

The Experiment Station bulletins containing botanical matter, which have come to hand since the last notice, are as follows: Some experiments with fungicides on peach foliage, by S. M. Bain (Tenn. vol. 8, no. 3); Effect of liming upon the development of potato tubers, by H. J. Wheeler, J. D. Towar and G. M. Tucker (R. I. no. 33), reaches the conclusion that lime upon sour soils increases the yield but also promotes the scab; Upon the effect of barnyard manure and various compounds of sodium, calcium and nitrogen upon the development of the potato scab, by H. J. Wheeler and G. M. Tucker (R. I. no. 33), a very full and important statement of the action of external conditions upon the growth of scab; Grape culture, by H. N. Starnes (Ga. no. 28) contains a brief account of fungous diseases and their treatment, black rot and root rot being considered far the worst; Notions about the spraying of trees, by L. H. Bailey (Cornell no. 101), enforces some fundamental ideas that must be kept in mind to obtain success in the use of fungicides; Treatment of currants and cherries to prevent spot diseases, by L. H. Pammel and G. W. Carver (Iowa no. 30), shows the efficiency of Bordeaux mixture; Squirrel-tail grass, Hordeum jubatum (Iowa no. 30), gives the results of much research, with a number of original illustrations; Studies of maple sap, by F. W. Morse (N. H. no. 32) is an interesting report on the flow of sap and the parts of the trunk from which it comes; Care of fruit trees with some reflections upon weeds, by L. H. Bailey (Cornell no. 102), gives some good advice not always kept in mind; The wild onion, Allium vineale, by R. L. Watts (Tenn. vol. 8, no. 2), an account of its distribution, habits and the methods of extermination.

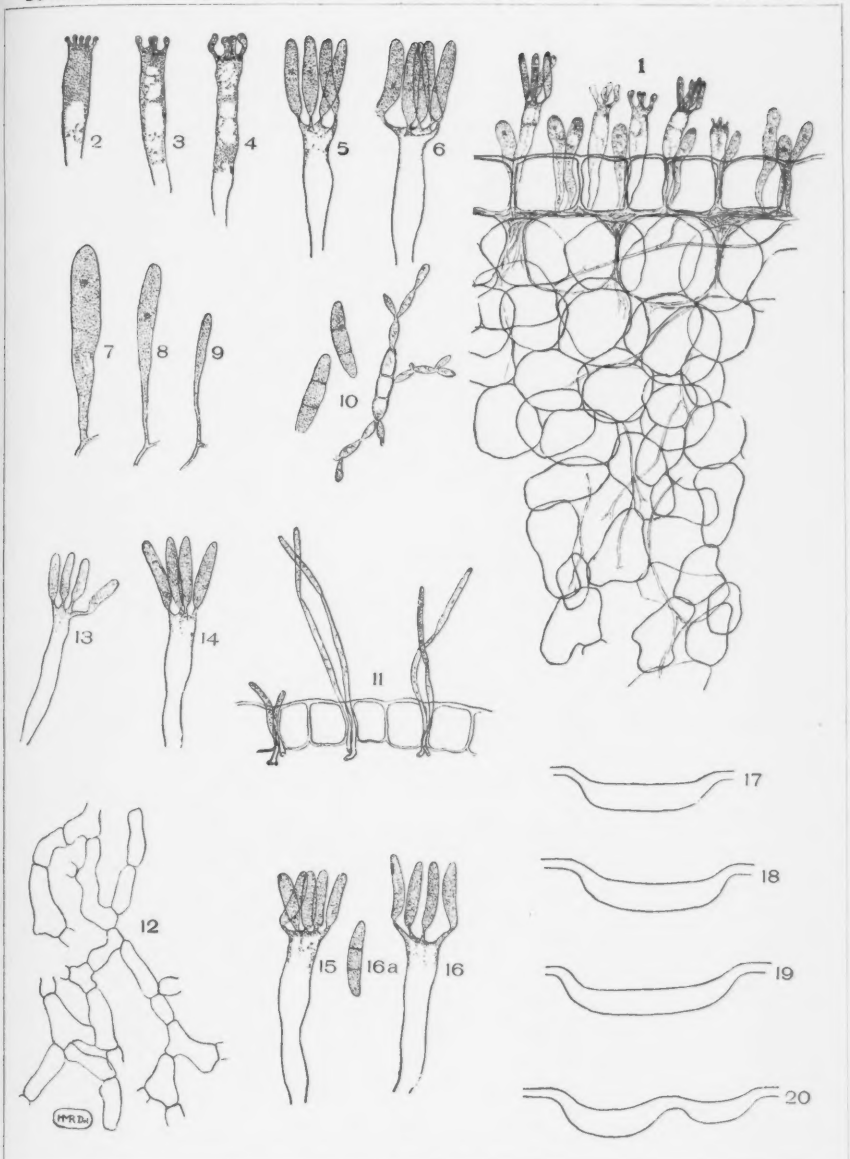
The Academy of Sciences of Iowa, Ohio and Indiana presented the following botanical subjects in their programs at the holiday sessions.

Iowa: Notes on the flora of western Iowa, by L. H. Pammel; Notes on grasses between Jefferson, Iowa, and the Rocky mountains in Colorado, by L. H. Pammel and F. Lamson-Scribner; Notes on chromogenic bacteria, by L. H. Pammel and R. Combs; Inoculation experiments with Gymnosporangium macropus, by F. C. Stewart and G. W.

Carver; Forest distribution in Iowa and its significance, and Notes on the problem of nomenclature as it appears in the Myxomycetes, by T. H. McBride; Some anatomical studies of the leaves of Sporobolus and Panicum, by Emma Pammel and Emma Sirrine; Perfect flowers in Salix, and Notes on the Iowa flora, by B. Shimek; A comparative study of the spores of North American ferns, by C. B. Weaver.

Ohio: List of white mildews in Cuyahoga, Erie and Medina counties, List of mosses and hepaticæ new to or rare in Ohio, Does Artemisia biennis live over winter, and Additions to the flora of Ohio and to those of certain counties, by Edo Claassen; A contribution to the flora of Fairfield county, and Formalin as a preservative of vegetable tissues, by E. M. Wilcox; Two new German handbooks of plant diseases, Some hitherto unlisted Ohio fungi, by Aug. D. Selby; Additions to the bibliography of Ohio botany, Distribution of the mistletoe in Ohio, Germination of seeds treated with fungicides, and The early Ohio botanists, by W. A. Kellerman; An analytical key to Ohio parasitic fungi, A freak of Cornus florida, and The parasitic fungi of Ohio, by F. L. Stevens; Flora of Erie county and the islands, by E. L. Moseley; The botanic garden and Institute at Leipzig, by G. M. Holferty.

Indiana: Botanical literature of the state library, and Microscopic slides of vegetable material for use in determinative work, by John S. Wright; Embryology of Hydrastis Canadensis, and Some determinative factors underlying plant variation, by Geo. W. Martin; The circulation of protoplasm in the manubrium of Chara fragilis, by D. W. Dennis; Flora of Turkey lake, by O. H. Meincke; Some beneficial results from the use of fungicides as a preventive of corn smut, by Wm. Stuart; Ratio of alcohol to yeast in fermentation, and Infection by bread, by Katherine E. Golden; Distribution of Orchidaceæ in Indiana, by Alice M. Cunningham; A new station for Pleodorina, by Severance Burrage; Report upon certain collections presented to State Biological Survey, Certain plants as an index of soil character, and Noteworthy Indiana phanerogams, by Stanley Coulter; Forms of Xanthium Canadense and X. strumarium, and An interchangeable clinostat of new design, by J. C. Arthur; Some notes on wood shrinkage, by M. J. Golden.



RICHARDS on EXOBASIDIUM.